In the United States Court of Federal Claims

OFFICE OF SPECIAL MASTERS

Filed: December 30, 2024

MATTHEW J. JOHNSON,	*	
	*	
	*	No. 16-1630V
Petitioner,	*	
v.	*	Special Master Gowen
	*	
SECRETARY OF HEALTH AND HUMAN SERVICES,	*	
	*	
Respondent.	*	

Richard Gage, Richard Gage, P.C., Cheyenne, WY, for petitioner.
Benjamin P. Warder, United States Department of Justice, Washington, DC for respondent.

RULING ON ENTITLEMENT[1]

On December 9, 2016, Matthew J. Johnson ("petitioner") filed a petition for compensation in the National Vaccine Injury Compensation Program.[2] Petition (ECF No. 1). Petitioner alleged as a result of receiving the hepatitis A/B vaccine (Twinrix) on March 18, 2015, he suffered from small fiber neuropathy ("SNF"). After an entitlement hearing and a review of the record, petitioner has established by preponderant evidence that he is entitled to compensation.

[1] Pursuant to the E-Government Act of 2002, see 44 U.S.C. § 3501 note (2012), **because this opinion contains a reasoned explanation for the action in this case, I intend to post it on the website of the United States Court of Federal Claims.** The Court's website is at http://www.uscfc.uscourts.gov/aggregator/sources/7. Before the opinion is posted on the Court's website, each party has 14 days to file a motion requesting redaction "of any information furnished by that party: (1) that is a trade secret or commercial or financial in substance and is privileged or confidential; or (2) that includes medical files or similar files, the disclosure of which would constitute a clearly unwarranted invasion of privacy." Vaccine Rule 18(b). An objecting party must provide the Court with a proposed redacted version of the opinion. *Id.* **If neither party files a motion for redaction within 14 days, the opinion will be posted on the Court's website without any changes.** *Id.*

[2] The National Vaccine Injury Compensation Program is set forth in Part 2 of the National Childhood Vaccine Injury Act of 1986, Pub. L. No. 99-660, 100 Stat. 3755, codified as amended, 42 U.S.C. §§ 300aa-10 to 34 (2012) (hereinafter "Vaccine Act" or "the Act"). Hereinafter, individual section references will be to 42 U.S.C. § 300aa of the Act.

I. Procedural History

Petitioner filed his claim for compensation on December 9, 2016. The petition was accompanied by medical records to support his claim. *See* Petitioner's ("Pet'r") Exhibits ("Ex.") 2-29 (ECF Nos. 16, 18, 26, 36).

On April 23, 2018, petitioner filed an expert report from Marcel Kinsbourne, MD. Pet. Ex. 30 (ECF No. 37). Respondent filed a responsive expert report from Vinay Chaudhry, MD. Respondent's ("Resp.") Ex. A (ECF No. 40).

I held a Rule 5 Status Conference on September 25, 2018. I explained that both experts wrote their reports prior to petitioner being seen by a neurologist and being prescribed Topamax, a medication for treating neuropathic pain. Rule 5 Order (ECF No. 42). Further, it appeared that petitioner's diagnosis of SFN was an outstanding issue that needed to be addressed by experts from both parties. *Id.* at 2.

Both parties filed supplemental expert reports. *See* Pet'r Ex. 45; Resp. Ex. B. On June 11, 2019, respondent filed the Rule 4(c) report recommending against compensation. Resp. Rept. (ECF No. 49). The undersigned held a Rule 5 status conference on June 25, 2019, when I recommended that the parties engage in settlement negotiations, as it appears that petitioner would likely prevail in this matter. Rule 5 Order (ECF No. 51). However, respondent maintained his position that "this case is not appropriate for compensation under the terms of the Vaccine Act," and settlement was not a possibility. Resp. Status Rept. (ECF No. 56).

Accordingly, an entitlement hearing was held on April 28, 2021, when Dr. James Bobenhouse, a treating neurologist, and Dr. Marcel Kinsbourne testified in support of petitioner's claim and Dr. Vinay Chaudhry appeared on behalf of respondent. Petitioner filed a post-hearing brief on September 1, 2021 and respondent filed a responsive post-hearing brief on January 18, 2022. *See* Pet'r Brief (ECF No. 87); Resp. Brief (ECF No. 91). This matter is now ripe for adjudication.

II. Petitioner's medical history

At the time of petitioner's vaccination, on March 18, 2015, petitioner was 37 years-old with a history of gastroesophageal reflux disease ("GERD"), low back pain treated with epidural injections, left knee pain and surgery, which was treated with epidural injections, sleep apnea, and had his gallbladder removed. *See* Pet'r Ex. 15 at 814,931, 939, 941, 956. Petitioner received the Twinrix Hepatitis A/B vaccine on March 18, 2015 from the Madonna Rehabilitation Hospital Employee Health & Safety Services. Pet'r Ex. 2.

On March 25, 2015, seven days post-vaccination, petitioner had an appointment with his primary care physician, Dr. Patrick J. Bertolini. Pet'r Ex. 4 at 1. Petitioner's "chief complaint" was pain primarily in the hips and shoulders. Petitioner reported that his pain was an 8/10 and the pain had lasted five days, since March 20, 2015. *Id.* The "History of Present Illness" provides:

> Pt comes in reporting that he started getting sick with myalgias and arthralgias, especially of the shoulders and hips. Started up on Friday, March 20, 2015. Started hepatitis B vaccine series on Wednesday, 3/18/2015. Has been having severe bilateral shoulder pain, bilateral hip pain. Most of the arthralgias are in the shoulders and hips. Had a lot of myalgias. Denies any fever or chills….Is having a little bit of left ankle pain. Has never had this kind of problem before. A month ago he and some friends went to Mexico. 1 of his friends was hospitalized due to Reiter's syndrome. Is worried that he might have picked up some type of disease in Mexico or the hepatitis B vaccine is causing him to have severe arthralgias and myalgias…Rates bilateral shoulder pain as an 8/10…Rates bilateral hip pain at an 8-9/10. Left ankle pain is on the lateral malleolus area of the left ankle. Otherwise, just kind of generalized myalgias of his arms and legs.

Id. Petitioner's physical exam showed that he had reduced range of motion in his shoulders bilaterally, including limited abduction, flexion, and extension. *Id.* at 2. He also had limited range of motion in hip movement, especially on abduction, adduction, internal and external rotation. *Id.* Petitioner's left ankle was tender to palpation over the left ankle lateral malleolus area. *Id.* Petitioner was diagnosed with "severe arthralgias and myalgias" and "severe bilateral shoulder pain, bilateral hip pain, secondary to possible viral etiology versus the possibility of a rheumatologic disorder, versus the possibility of a reaction to the hepatitis B vaccine. *Id.* at 3.

The next day, Thursday, March 26, 2015, petitioner presented to the emergency department of Bryan Medical Center for fatigue and body aches. Pet'r Ex. 5. Petitioner reported that "since Friday he has had extreme fatigue, joint pains, and achiness." *Id.* at 1. Petitioner reported that he received a hepatitis vaccine the previous Wednesday. *Id.* Petitioner had a full lab work-up in the emergency department, where he was negative for influenza, his EKG was normal, and his chest x-ray also appeared normal. *Id.* at 7. Petitioner was discharged after a shot of Toradol and morphine and given a prescription for hydrocodone. *Id.*

On March 27, 2015, petitioner returned to the emergency department of Bryan Medical Center, again complaining of fatigue and weakness. Pet'r Ex. 6 at 1. This time he was admitted to the hospital until March 31, 2015. *Id.* His discharge diagnosis included, "myalgias, arthralgias with severe fatigue and body ache following a combination vaccination for hepatitis A and hepatitis B," along with obstructive sleep apnea, gastroesophageal reflux, and acute transaminitis,[3] gradually improving." *Id.* at 1. An ultrasound of petitioner's abdomen showed hepatosplenomegaly, fatty infiltration of the liver, and status post-cholecystectomy. *Id.* Petitioner's IgM to cytomegalovirus was negative and he had a borderline positive IgG. Under "Reason for Hospital Admission and Hospital Course," it notes that petitioner "received a combination vaccine for hepatitis A and B. Within two days [petitioner] started having myalgias, arthralgias. He felt very fatigued and weak. He felt like he wanted to sleep all the time…..Autoimmune hepatitis workup is currently still in progress. We are going to do a workup for chronic liver disease that is all in progress." *Id.* at 2.

[3] Transaminitis is high levels of transaminase, which are enzymes released into the blood by the liver. Transaminitis, Cleveland Clinic, March 14, 2024, https://my.clevelandclinic.org/health/symptoms/transaminitis, last accessed on December 2, 2024.

While petitioner was hospitalized, he was seen by infectious disease specialist, Dr. Paul N. Gobbo. Pet'r Ex. 7 at 1. Dr. Gobbo recorded that petitioner received the Twinrix vaccine on March [18] and that within two or three days, petitioner began to develop "extreme fatigue and malaise along with generalized arthralgias which seemed to start especially in the hips and shoulders, eventually involving pretty much all of his joints." *Id.* Petitioner did not have any significant joint swelling and did not have any fever or chills. *Id.* During the physical exam, Dr. Gobbo recorded that petitioner may have "trace edema of the lower extremities, but there were no significant joint effusions noted," and that petitioner had "good range of motion at both the knees and hips, but did have some pain on cross-leg testing bilaterally." *Id.* at 2. Dr. Gobbo's impression was a "vaccine reaction to the Twinrix causing a serum sickness-type reaction which manifests mainly as poly-arthralgias and severe fatigue." *Id.* at 3. Dr. Gobbo placed petitioner on high-dose ibuprofen three times a day and wanted to check for an autoimmune disease. *Id.*

After his hospitalization, petitioner had an appointment with Dr. Bertolini on April 3, 2015. Pet'r Ex. 14 at 100. Petitioner reported having pain in his knees and feet and that he was now experiencing paresthesias and dysesthesias of his feet bilaterally. *Id.* Most of the pain was still in his shoulders and hips. *Id.* Petitioner demonstrated limited range of motion for his shoulders and a slow wide stance and antalgic gait due to bilateral hip pain. *Id.* at 102. Dr. Bertolini diagnosed petitioner with "multiple joint arthropathy, especially of the shoulders and knees bilaterally due to vaccine induced arthropathy with limited range of motion of the shoulders and hips and complaints of weakness of his arms and legs and paresthesias and dysesthesias of his feet bilaterally secondary to the hepatitis A and B combination vaccine administered mandatorily for work purposes." *Id.* at 102.

Petitioner was hospitalized again from April 7 to April 10, 2015. While he was hospitalized, petitioner was seen by neurologist, Dr. Sunil Nadir, because petitioner was experiencing numbness and tingling in his hands and feet, which were concerning for Guillain-Barre syndrome. Pet'r Ex. 9 at 1. Dr. Nadir examined petitioner and found he had abnormal sensation to pinprick on the dorsum of the hands and distal forearm and in the dorsum of his feet. *Id.* Additionally, sensation to vibration was mildly decreased over petitioner's knuckles and toes. *Id.* at 2. Dr. Nadir opined that petitioner did not have GBS because petitioner's strength and reflexes were preserved. *Id.* at 3. Petitioner had a consultation with rheumatologist, Dr. Rick C. Chatwell, who recorded that petitioner had been complaining of weakness and "a cold, numb sensation involving his extremities, particularly his feet." Pet'r Ex. 8 at 5. He wrote that petitioner was complaining of arthralgias involving the large joints, particularly his shoulders and hips, and notably did not experience any defined fevers, chills, night sweats, or skin rashes. *Id.* Dr. Chatwell's impression was:

> Migratory severe polyarthralgias with large joint predominance. Differential diagnosis includes a reactive phenomenon such as a post vaccination? Or post viral etiology. The patient lacks fevers or skin rash to suggest adult-onset of Still disease and his current clinical presentation is not suggestive of a rheumatoid arthritis, systemic lupus erythematosus, etc. No obvious preceding infection has been defined…..5. Sensory neuropathy?

Id. at 7. Dr. Chatwell began petitioner on a corticosteroid therapy, beginning with 30 mg of prednisone. *Id.*

Petitioner had an appointment with neurologist, Dr. Robert Sundell on April 17, 2015. Pet'r Ex. 24. Petitioner reported that since he was first hospitalized in late March, his feet have been cold and his hands "feel like big balloons or Mario brother hands," and that "the top half of his hands and feet feel different." *Id.* at 8. Petitioner had decreased sensation to pinprick on his feet until above his ankles bilaterally and decreased sensation to pinprick until his elbows. *Id.* at 9. Dr. Sundell recommended that petitioner have an EMG/NCS and an MRI to rule out any myelopathic process. *Id.* at 8.

Petitioner underwent an EMG/NCS on April 24, 2015. Pet'r Ex. 24 at 4. The impression of the exam was, "Entirely normal examination of the right upper and right lower extremities without indications of distal polyneuropathy or radiculopathy." *Id.* at 7. Petitioner's sensory responses for the median and ulnar nerves "were also well within normal limits." *Id.* At an appointment with Dr. Sundell, petitioner reported that his symptoms are "somewhat better," but that he still suffered from significant joint pain. Pet'r Ex. 10 at 1. Petitioner had reflexes and his strength in his deltoid and interossei were marked as "good." *Id.* However, petitioner still experienced decreased sensation to pinprick on the dorsal surface of his forearm and his sensation to vibration on his knuckles had improved, while he had intact sensation to vibration in his ankles. *Id.* Dr. Sundell stated that he "cannot find a definite neurological cause for his subjective sensory symptoms. He continues to have pain symptoms in his joints for which he is seeing Dr. Palmer." *Id.* No follow-up was scheduled.

At an appointment with Dr. Bertolini on September 4, 2015, petitioner explained that he was no longer having any myalgias or arthralgias, however, he was still having problems with paresthesias and decreased sensation to light touch. Pet'r Ex. 14 at 57. Additionally, he had diminished sensation to cold and hot temperatures, and it was presenting in a "stocking/glove distribution" that was affecting his hands to his elbows bilaterally and affecting his feet and toes up to his knees. *Id.* Petitioner had decreased sensation to light touch of his occipital scalp and left anterior chest and left lateral neck area. *Id.* On his neurological exam, he demonstrated abnormal sensation to light touch, including decreased sensation to light touch and pinprick at the hands and feet in a stocking glove pattern. *Id.* at 60. Dr. Bertolini diagnosed petitioner with "disturbance of skin sensation," along with "polyarthritis," and "polyarthropathy or polyarthritis of multiple sites." *Id.* Dr. Bertolini also wrote, "Hepatitis A and B vaccine reaction with myalgias, arthralgias which is improving but with persistent paresthesias and dysesthesia of the hands and feet to the mid-elbows and to the knees bilaterally in a stocking and glove distribution." *Id.* at 61.

Petitioner had another appointment with Dr. Gobbo on October 15, 2015 for "vertigo and low blood sugar." Pet'r Ex. 18 at 3. Petitioner reported having generalized fatigue and tiredness, as well as numbness of his extremities "from just above the elbows down, and from the knees on down." *Id.* However, his arthralgias were not quite as severe at the time. *Id.* Dr. Gobbo wrote that "[t]he etiology of his symptoms is unclear, but all seem to stem from the Twinrix vaccination last March, so suspect idiosyncratic reaction." *Id.* at 4.

On November 12, 2015, petitioner had an appointment with Dr. Sara May, an allergist. Pet'r Ex. 11 at 1. Dr. May reviewed petitioner's history and noted that petitioner had been to several specialists, including neurologists, rheumatologists, and gastroenterologists, to determine what has caused his underlying symptoms. *Id.* She wrote that the onset of petitioner's symptoms, mainly arthralgias and myalgias, occurred after he received the Twinrix vaccine. *Id.* Petitioner's symptoms had resolved since he began taking Cymbalta and gabapentin. *Id.* The main symptoms he was experiencing was bilateral hand and feet numbness. *Id.* Petitioner also reported that he was having significant flushing and diaphoresis but has never had his autonomic nervous system evaluated. *Id.* Dr. May stated that, "Review of FDA approved package insert for this vaccine reveals that patient can have headaches as well as arthralgias myalgias and some of the symptoms he describes. It is also noted that Neomycin is in the vaccine." *Id.* However, she did not list the significance of Neomycin in her evaluation. After she performed a physical exam of the petitioner Dr. May wrote:

> I was asked to see [petitioner] to determine if this was a serum sickness reaction to the Twinrix vaccine. He denies rash or fever and both of these are generally seen with serum sickness. In addition, the treatment of serum sickness is removal of the drug and should improve within a couple of weeks. Symptomatic treatment can be used, including steroids, which he received. *Some of his symptoms were noted in a small amount (<1%) of patients that received this vaccine.* There is no way to evaluate if the initial episode was serum sickness, but unlikely based on history and treatment has already been done. *However, this could have increased his immune system reactivity and started a new problem.* Based on the above listed symptoms, I am more concerned about an autonomic dysfunction or almost POTS. In addition, need to rule out underlying mast cell disease.

Id. at 2 (emphasis added). Petitioner's blood work and tryptase levels were normal. *Id.* at 3.

Petitioner had an appointment with Dr. Bertolini on January 26, 2016, for right arm pain, along with numbness and paresthesias. Pet'r Ex. 14 at 22. Petitioner reported that he was having "persistent tingling and numbness of his arms and legs from the shoulders down to his fingers and from his knees down to his toes." *Id.* Dr. Bertolini wrote, "he has been having problems with persistent paresthesias, numbness of his arms and legs since the vaccine reaction." *Id.* Petitioner was having problems at work performing fine dexterity manipulation of tools, bolts, and screws because of the tingling and numbness in his fingers." *Id.* Under current "Preventative Care" it listed "hepatitis B vaccine: 3/18/2015 Twinrix with post-vaccine polyarthropathy with elevated LFTs." *Id.* Petitioner had abnormal sensation to light touch, which was marked as "diminished hands and lower legs bilaterally, abnormal sensation to pain, peripheral nerves were abnormal and leg numbness and paresthesias." *Id.* at 25. Petitioner had normal gait and motor function. *Id.* Petitioner's primary diagnosis was, "chronic numbness, tingling, and paresthesias of his arms and legs, *stocking glove neuropathy due to post-Hepatitis A and B vaccine reaction causing polyarthropathy* and elevated liver function test. Vaccine was given on 3/18/2015 and was hospitalized on March 27, 2015 for post-hepatitis A and B vaccine reaction." *Id.* (emphasis added).

On May 9, 2016, petitioner had an Autonomic Reflex Screen ("ARS") and a Quantitative Sensory Test ("QST"). Pet'r Ex. 25. The QSART test showed that petitioner had normal sweat

output at the left forearm, leg, and foot. *Id.* at 2. His heart rate response to deep breathing was normal and his beat-to-beat blood pressure response was normal. *Id.* However, petitioner's QST showed "elevated vibratory, cooling, and heat-pain thresholds." *Id.* Dr. Pariwat Thaisetthawatkul wrote that petitioner's EMG/NCS showed no evidence of large fiber neuropathy, myopathy, or lumbosacral radiculopathy and that the blood tests are "unremarkable." *Id.* Dr. Thaisetthawatkul wrote that there was "no evidence from electrophysiological studies to indicate a neuromuscular cause for his symptoms," but ordered a skin biopsy to determine if petitioner has small fiber neuropathy. *Id.*

On July 26, 2016, petitioner saw Dr. Pariwat Thaisetthawatkul at the University of Nebraska Neuromuscular Clinic for skin biopsy to determine if petitioner "could have small fiber neuropathy that may explain the numbness/pain symptoms." Pet'r Ex. 22 at 1. One sample was taken from above his right ankle and another from his right upper thigh. *Id.* The samples were mailed to the University of Rochester Medical Center for analysis. *Id.* at 6. The results from the ankle sample show that "epidermal nerve fiber density is within normal limits for age, when assessing dermal-epidermal junction crossing fibers. The epidermal nerve fiber density estimate is 11.1 fibers/mm (normal >5.2 fibers/mm). Morphologic analysis shows some small and medium sized axonal swellings." *Id.* at 9. The sample from petitioner's right thigh did not show any significant axonal swelling in the morphologic analysis. *Id.* The final diagnosis from the neuropathology report provided, "No clear pathologic evidence of a small fiber neuropathy based on epidermal nerve fiber densities at the distal leg and proximal thigh." *Id.* at 13. Dr. Thaisettawatkul contacted petitioner and informed him that the skin biopsy results from the University of Rochester "came back normal and show no evidence of small fiber neuropathy." *Id.* at 16. Dr. Thaisettawatkul also wrote, "Surely he does not have peripheral neuropathy, either large or small fiber neuropathy to explain his numbness/tingling." *Id.*

On September 1, 2016, petitioner had an appointment with Dr. Gobbo and reported that he reported improved joint pain, although still present. Pet'r Ex. 18 at 1. His pain in his knees, shoulders, hips, and elbows were now intermittent. *Id.* He also told Dr. Gobbo that he was having numbness of the upper extremity, from the elbows down and from the knees down. *Id.* Dr. Gobbo recorded that skin biopsies were done, looking for small nerve fiber pathology, but none was found. *Id.* Dr. Gobbo wrote, "The temporal relation of his symptoms, especially the fatigue and arthralgias, shortly after the Twinrix vaccination, suggests an idiosyncratic reaction to the vaccine as the most likely cause of his problems." *Id.* The physical exam found that petitioner had "decreased sensation of forearms, hands, legs, and feet to touch and pinprick," with his reflexes intact. *Id.* at 2. He was assessed with "numbness of limbs," and "vaccine adverse reaction, Twinrix." *Id.*

Dr. Gobbo wrote a letter on November 15, 2016 stating that he has treated petitioner since April 2015. Pet'r Ex. 7 at 10. Dr. Gobbo wrote that petitioner received the Twinrix vaccine on March 17, 2015 because of his occupation as plumber with risk of exposure to hepatitis A and B. *Id.* He stated that "shortly after receiving the vaccine, [petitioner] developed progressively worsening joint pains, especially around his shoulders, hips, as well as other joints." *Id.* Dr. Gobbo wrote that petitioner was still experiencing fatigue, as well as continued polyarthralgias, mainly involving the knees, shoulders, hips, and elbows. *Id.* Petitioner continued to experience paresthesias, or tingling and numb sensation of the upper extremities

from the elbows down, as well as the lower extremities from the knees down. *Id.* Dr. Gobbo stated, "No specific cause or disease was ever found to explain these symptoms, but the temporal relation to the Twinrix vaccination very strongly suggests that he had an idiosyncratic adverse reaction to the vaccine, with continued post-vaccination polyarthralgias and peripheral neuropathy with paresthesias of the distal limbs." *Id.*

Petitioner returned to Dr. Gobbo on April 16, 2018, 37 months post-vaccination. Pet'r Ex. 42 at 1. Dr. Gobbo stated that petitioner was there for a follow-up evaluation and consideration of a repeat nerve biopsy. *Id.* Dr. Gobbo noted that the previous skin biopsy petitioner had in 2016 "did not demonstrate any specific pathology, but there was some concern about early-stage nerve damage, especially with axonal swelling of the small and medium nerves." *Id.* Additionally, Dr. Gobbo noted that petitioner had now brought his vaccine claim. *Id.* At the time of the appointment, petitioner was still experiencing joint pains and myalgias predominantly in his lower extremities and numbness, as well as "marked fatigue." *Id.* The objective physical exam did not reveal any "significant motor or sensory deficits." *Id.* Dr. Gobbo stated that he would consult with a neurosurgical specialist, Dr. Steven Gogela for consideration of a repeat scan and nerve biopsy. *Id.*

Dr. Gogela wrote to Dr. Gobbo on April 24, 2018, and stated that a repeat nerve biopsy "could certainly be indicated for him, [at] this point, as we seek further information regarding the nature of his condition." *Id.* at 4. He also opined that petitioner should also have a "repeat neurological evaluation to guide the biopsy and interpret the results." *Id.* Dr. Gogela referred petitioner to Neurology Associates for a detailed evaluation prior to proceeding with a repeat nerve biopsy. *Id.*

Petitioner had his first appointment with Dr. James Bobenhouse, a neurologist, on May 11, 2018. Pet'r Ex. 43. Dr. Bobenhouse provided a brief summary of petitioner's medical history, which is as follows:

> …he is a 40-year-old right-handed white male, who states that he had been in good health except for obstructive sleep apnea up until 2015 when he received a hepatitis A and B vaccine as a requirement for his work. Approximately three days later, he said that he felt disoriented and had diffuse joint pains. He says that he felt generally weak and had diffuse pain, which worsened with exertion. The pain was essentially incapacitating and at times, he says that he screamed because of the discomfort…..He was subsequently hospitalized for 10 days on and off work for a total of seven months. He was seen by Dr. Thai at UNMC and [a] nerve condition study was performed, which apparently was negative….He also had a probable nerve and muscles biopsies, which were also inconclusive. He was thought to have an autonomic or small fiber neuropathy, which was precipitated by the hepatitis vaccine.

Id. Petitioner continued to have paresthesias and dysesthesias in his feet and forelegs, as well as in his hands and forearms. *Id.* Petitioner also endorsed shocking pains in his feet intermittently. *Id.* He also described the pain as like "knives" in his hips, knees, shoulder, and elbows. *Id.* The physical exam showed that petitioner had decreased sensation to pinprick and light touch in his legs and feet, but he had normal vibratory and proprioceptive sensation in his feet. *Id.* at 3.

Additionally, petitioner had altered sensation in his hands with decreased sensation to pinprick and light touch. *Id.* There was also a slightly altered sensation over petitioner's forearms bilaterally. *Id.* Petitioner had sensory loss over the abdomen below the T8 level. *Id.* Petitioner also had decreased deep tendon reflexes, having absent right knee reflex and trace in his left, along with an absent right ankle reflex. *Id.*

Petitioner's repeat EMG/NCS was considered normal "with no evidence of radiculopathy, plexopathy, myopathy, or large fiber sensory neuropathy." *Id.* at 3, 5-6. Dr. Bobenhouse diagnosed him with "diffuse arm and leg paresthesias/dysesthesias, suspect secondary to small fiber sensory neuropathy in association with the hepatitis vaccine." *Id.* at 3. A repeat skin biopsy was not ordered.

Petitioner returned to Dr. Bobenhouse on March 23, 2020. Pet'r Ex. 47. Petitioner reported that the Topamax was helping, but he still experienced hand and foot dysesthesias, and if he missed a dose, the pain was much worse. *Id.* at 1. When using his hands for fine motor tasks, it aggravates his pain. *Id.* For example, the use of his smoker makes it so he cannot hold a fork afterwards because of the severe pain and tremors in his hands. *Id.* Petitioner endorsed cold sensations in his feet and forelegs and his hands and forearms bilaterally. *Id.* Petitioner's sensory exam was positive for decreased sensation to pinprick in his feet and hands bilaterally. *Id.* at 2. He also had altered sensation to light touch in his forearms and forelegs bilaterally. Additionally, petitioner had absent deep tendon reflexes in his knees and ankles bilaterally. *Id.* Dr. Bobenhouse diagnosed petitioner with "bilateral foreleg and foot, forearm and hand paresthesias and dysesthesias. This is most likely due to small fiber sensory neuropathy in association with the hepatitis [A] & B vaccine in 2015." *Id.* at 3.

Dr. Bobenhouse called Re-Entry Rehabilitation services the same day stating that it was his opinion that petitioner has "forearm and hand, and foreleg and foot paresthesias and dysesthesias due to small fiber sensory neuropathy associated with the hepatitis vaccine." *Id.* at 7. Dr. Bobenhouse stated that petitioner would likely need to continue ongoing therapy with Topamax and anti-depression medication. *Id.* Additionally, Dr. Bobenhouse wrote that petitioner may need assistance in performing physical and strenuous activities, such as lawn mowing because of his ongoing hand and foot pain and dysesthesias. *Id.*

Re-entry Rehabilitation service coordinator, Ms. Liz Kattaman sent a letter back to Dr. Bobenhouse, summarizing their conversation and included an additional assessment of what petitioner may need in terms of long-term care. *Id.* at 7. The letter states that petitioner has "autonomic or small fiber sensory neuropathy precipitated by the hepatitis vaccine," and that petitioner's primary symptoms are "paresthesias and dysesthesias in his forearms and legs, hands, and feet bilaterally." *Id.* Petitioner's condition between 2018 and 2020 did not change and Dr. Bobenhouse indicated that petitioner would need one or two neurology visits per year for the rest of his life and that he will require Topamax or a similar medication long term. *Id.* Additionally, due to petitioner's condition, his mental health has been affected and petitioner will likely need an anti-depressant like Effexor for the long term as well. *Id.* Petitioner is likely to need some assistance in doing heavier household work, such as snow removal and yard work. *Id.*

III. Experts' opinions on petitioner's diagnosis and vaccine causation

a. Dr. James Bobenhouse

Dr. Bobenhouse, one of petitioner's treating neurologists, testified during the entitlement hearing. Transcript ("Tr.") 5-44. Dr. Bobenhouse testified that he treats patients with a "wide range of neurological problems," with a quarter of his practice focused on neuromuscular issues, such as peripheral neuropathy and carpal tunnel syndrome. Tr. 6. He stated that he also treats patients with myasthenia gravis and Guillain-Barré syndrome. *Id.*

Dr. Bobenhouse testified that he diagnosed petitioner with small fiber sensory neuropathy. *Id.* at 7. He stated that when petitioner first presented to him in May 2018, petitioner complaining of "shock-like pains in his hands and feet and his examination was consistent with small fiber sensory neuropathy." *Id.* He stated that although petitioner had an extensive work-up by neurologist Dr. Thaisetthawatkul, including an EMG/NCS and nerve biopsies, which were normal and ruled out other types of neuropathy, including small fiber neuropathy, he felt comfortable in making the diagnosis of small fiber sensory neuropathy based on the history and examination at the time that he saw him. *Id.*

Dr. Bobenhouse explained that petitioner had no evidence of muscle weakness, cardiac exam was normal, blood pressure was normal, and his cerebellar testing was normal. Tr. 9. Dr. Bobenhouse stated that a drop in blood pressure may have represented evidence of neuropathy or autonomic neuropathy, but there was no evidence of that. Tr. 8. Additionally, even though petitioner had generally diminished reflexes, including absent right ankle jerk and trace reflexes in the knees, those were essentially normal. *Id.* Dr. Bobenhouse stated that everyone has different reflexes, and some athletes can have minimal or absent reflexes, which can indicate a neuropathy or it can be the normal range. Tr. 11. Dr. Bobenhouse testified that there is a "wide range" of normal for absent or decreased reflexes, so its only one factor that he takes into consideration when examining a patient. *Id.* Later Dr. Bobenhouse clarified that the petitioner's diminished reflexes were not that important to determine whether petitioner had small fiber neuropathy. Tr. 40. He stated that patients can have both large and small fiber neuropathy at the same time, often seen in diabetics. *Id.*

Dr. Bobenhouse testified that petitioner's symptoms of shock-like pains in his hands and feet, and his sensory exam results fit the pattern of sensory neuropathy. Tr. 13. He stated that petitioner's sensory exam revealed decreased pinprick and light touch testing in his feet and legs bilaterally. Tr. 8. Petitioner also had altered sensation in the hands with decreased pinprick and light touch sensation, in a "stocking-glove type distribution." *Id.* Dr. Bobenhouse testified that petitioner also had decreased pinprick sensitivity at the T8 level as well. *Id.* He indicated that petitioner's sensory issues at the T8 level was not part of petitioner's small fiber sensory neuropathy. *Id.* at 25. Dr. Bobenhouse stated that the nerve conduction test that he performed on petitioner's left leg was normal, so he was able to rule out large fiber neuropathy, large fiber sensory neuropathy and motor neuropathy. Tr. 12.

Dr. Bobenhouse testified that petitioner's description of his shooting pain, the normal nerve conduction test showing no large fiber neuropathy, and the EMG needle exam showing no muscle changes to suggest another process, all fit with the diagnosis of a small fiber sensory neuropathy. Tr. 13. Dr. Bobenhouse also stated that petitioner's symptoms of numbness in a stocking-glove distribution is consistent with a length-dependent type of sensory neuropathy. *Id.* He explained that in small fiber neuropathies there are non-length dependent and length-dependent, and the length-dependent neuropathy means it is at the very end of the nerves, which would implicate the fingertips and toes. *Id.* at 12-13.

Dr. Bobenhouse stated that small fiber neuropathy was progressive. Tr. 16. He testified that patients seem to get worse over time and medicines lose their efficacy. *Id.* Dr. Bobenhouse stated that he believed that petitioner's small fiber sensory neuropathy was progressive, as medicines that were helpful at one time lost their efficacy overtime. *Id.* Dr. Bobenhouse testified that prior to petitioner coming to him for treatment, the petitioner had tried gabapentin, Lyrica, and duloxetine with little or no success. *Id.* Additionally, petitioner did not respond to a course of steroids. *Id.* at 14. Dr. Bobenhouse started petitioner on a trial course of Topamax, which is an anticonvulsant, that is used to treat small fiber neuropathy. *Id.* at 14. Petitioner improved with Topamax initially, but then the pain seemed to worsen, so Dr. Bobenhouse started petitioner on venlafaxine.[4] *Id.* However, petitioner experienced some negative side effects and was weaned from venlafaxine. *Id.* Petitioner ultimately returned to Topamax. *Id.*

When Dr. Bobenhouse reviewed petitioner's skin biopsy on cross-examination, he acknowledged that the pathologist's finding was that there was "no clear pathological evidence of a small fiber sensory neuropathy," but he observed that the biopsy showed evidence of axonal swelling of the small and medium-sized axons, which he stated was not "entirely normal." Tr. 23-24; *see also* Pet'r Ex. 22 at 7. Additionally, Dr. Bobenhouse disagreed with Dr. Thaisetthawatkul's conclusion that petitioner did not have small fiber neuropathy. *Id.* at 24.

Dr. Bobenhouse explained that petitioner's initial symptoms of pain in the shoulders and hips were not necessarily directly related to petitioner's diagnosis of small fiber sensory neuropathy, but they were "probably…a reaction to the vaccine." *Id.* at 31. He stated that the shoulder and hip pain seemed "more of a systemic type response initially, which can occur when a person receives a vaccination," and was likely unrelated to petitioner's later diagnosis of small fiber neuropathy. *Id.* Petitioner began experiencing the shock-like pain in his feet in about a week to ten days after the vaccination. Tr. 32. Then petitioner's sensory symptoms progressed to pain in his fingers and toes. Tr. 33. The diffuse pain petitioner described was part of the small fiber neuropathy process. *Id.* at 34. Dr. Bobenhouse stated that "non-length dependent small fiber neuropathy can be more diffuse and can cause pains in other places" with the hands and feet being most symptomatic. *Id.*

Dr. Bobenhouse reviewed petitioner's physical therapy notes from April 2015, which would have been approximately one-month post-vaccination, when petitioner reported shooting pains in his legs at night. Tr. 42; *see also* Pet'r Ex. 69 at 2. Dr. Bobenhouse testified that the description of shooting pain was consistent with neuropathic pain. *Id.* In addition, petitioner complained of tingling and increased coldness in his feet. *Id.* He also observed that the physical

[4] Venlafaxine-a serotonin and norepenepherine receptor inhibitor with a brand name of Effexor.

therapy records also recorded that petitioner had numbness in a "glove-stocking distribution" in the hands and feet. *Id.*

In addition to the pain, petitioner's complaints of the sensation of "severe cold" on the dorsal surface of his feet contributed to the small fiber neuropathy diagnosis. *Id.* at 35. Dr. Bobenhouse explained that nerve fibers can detect pain and temperature, and when those nerves become damaged, the nerves give the wrong signal. *Id.* at 36. This results in an altered sensation "not only for pinprick, but also for cold and warm." *Id.* Frequently patients will complain of burning, but also can complain of a feeling of coldness in the feet. *Id.* When reviewing the petitioner's QST testing, which showed that petitioner was in the 98th percentile for vibration and 99th percentile for heat and cold thresholds, Dr. Bobenhouse explained that someone in the 98th and 99th percentile for heat and cold thresholds means "that it takes that much effort to feel that sensation, so it's an increased threshold to cause the cold or warm feeling." *Id.* Dr. Bobenhouse stated that the C fibers and A-delta fibers detect temperatures and pain, and if there is an impairment when those fibers are damaged, aberrant signals are being sent to the brain which would decrease the sensitivity for those modalities. *Id.* at 37. He explained that the disruption or abnormal signal from the nerve fibers to the brain can give rise to the decreased sensitivity to heat or cold temperatures. *Id.* He also explained that a person in this category can have altered sensations of hot and cold causing him to experience burning or extreme cold sensations particularly in the feet and hands. Tr. 36

When asked if he had considered ordering another skin biopsy, Dr. Bobenhouse explained that he did not feel like another biopsy would be beneficial because the first one petitioner had was inconclusive and the biopsies "have a low yield as far as determining the etiology for small fiber neuropathy." Tr. 38. He testified that "if the work-up has already been done, then I just [did not] feel like it was necessary to do another biopsy." *Id.* Dr. Bobenhouse also stated that the diagnosis of small fiber neuropathy can be done clinically without the confirmation from a skin biopsy. He said ultimately, he is trying to treat the symptoms which were consistent with small fiber neuropathy. *Id.*

He agreed with the definition of dysesthesias a type of chronic nerve disorder that can cause prickling, burning, stabbing, ice cold and/or electrical sensations and can affect the arms, hands, legs and/or feet. *Id.* Dr. Bobenhouse stated that at the time that petitioner came to him in 2018, he had been suffering with dysesthesias. He said that the dysesthesias that petitioner was experiencing were caused by small fiber neuropathy Tr. 41

b. Dr. Marcel Kinsbourne

1. Petitioner's diagnosis

Dr. Marcel Kinsbourne submitted three expert reports and testified at the entitlement hearing. Pet'r Exs. 30, 45, & 63. Dr. Kinsbourne opined that after receiving the Twinrix vaccination on March 18, 2015, petitioner developed an autoimmune disorder with the clinical picture of neuropathic pain, paresthesias, and sensory deficits for temperature and fatigue most consistent with non-length dependent small fiber neuropathy. Pet'r Ex. 30 at 4; Tr. 48.

Dr. Kinsbourne explained that "small fiber neuropathy is a disorder of small somatic nerve fibers and often also autonomic nerve fibers. Small nerve fibers include lightly myelinated A-delta fibers and unmyelinated C fibers, which innervate the skin." Pet'r Ex. 30 at 4. A-delta fibers, which are lightly myelinated, mediate fast stabbing pain and light touch, while C fibers mediate slow, burning pain and the ability to appreciate pinprick and hot and cold temperatures. Pet'r Ex. 45 at 2. The article by Hovaguimian and Gibbons states that "Small fiber neuropathy manifests in a variety of different diseases and often results in symptoms of burning pain, shooting pain, allodynia, and hyperesthesia." Pet'r Ex. 66.[5] The authors explain that "most small fiber neuropathies occur in a length dependent fashion, resulting in loss of function in a stocking-glove distribution in the lower extremities….In rare cases, a non-length dependent neuropathy results in symptoms involving the trunk, face, proximal limbs, or other focal areas." *Id.* at 1. Severe symptoms of small fiber neuropathy may include burning pain and many patients also report "transient electric shock-like pain, usually lasting only seconds, but quite severe and potentially multiple times a day." *Id.* at 2.

An article by Tavee and Zhou explains that in patients with small fiber neuropathy, findings on neurologic examination, nerve conduction studies, and electromyography are normal, although some show signs of mild distal sensory loss on physical examination. Pet'r Ex. 57 at 1.[6] The damage or loss of small somatic nerve fibers results in pain, burning, tingling, or numbness that typically affects the limbs in a distal-to-proximal gradient. *Id.* at 2. The authors indicated that "the most bothersome and fairly typical symptom is burning pain in the feet that extends proximally in a stocking-glove distribution and is often accompanied by stabbing or aching pains, electric shock-like or pins-and-needles sensations." *Id.* at 2. The symptoms usually are worse at night and often affect sleep. *Id.*

Dr. Kinsbourne testified that petitioner's initial joint pains following vaccination was consistent with a severe vaccine reaction. Tr. 50. He stated that "the joint pain is a well know, severe but transitory adverse effect of multiple vaccinations." *Id.* Dr. Kinsbourne explained that when petitioner was first hospitalized on March 27, 2015, his C-reactive protein level increased to 2.6 from 0.3, and his liver function tests, specifically AST went up to 369 and the ALT level was 368, which were all consistent with an inflammatory response to the vaccine. Tr. 55. He also observed that petitioner's medical records were negative for joint swelling, rash, chills or fever, which would indicate that there was "no active infection" but that petitioner was experiencing polyarthralgia and severe fatigue, which was most suggestive of an autoimmune process. Tr. 56.

Dr. Kinsbourne testified that when petitioner was reporting feeling hot constantly and tingling in his feet, along with increased coldness, it was the beginning of petitioner's small fiber neuropathy. Tr. 58. He stated that petitioner's whole body hurting "isn't classical for length-dependent neuropathy, but the feet tingling constantly with increased coldness is exactly what [one] would expect." *Id.* Additionally, petitioner's reports of shooting pains are also consistent

[5] Alexandra Hovaguimian, *Diagnosis and Treatment of Pain in Small Fiber Neuropathy*, 15(3) Curr. Pain Headache Rep., 193-200 (2011). [Pet'r Ex. 66].

[6] Jinny Tavee & Lan Zhou, *Small Fiber Neuropathy: A burning problem*, 76 Cleveland Clinic J. of Med. 297-305 (2009). [Pet'r Ex. 57].

with neuropathic pain. Tr. 59. Dr. Kinsbourne observed that treating physician, Dr. Nair, ruled out acute demyelinating polyradiculopathy or GBS, a long fiber neuropathy, because petitioner's strength and reflexes were preserved. Tr. 62. This is important because "it was the small fibers that were involved throughout." *Id.* Additionally, petitioner's treating rheumatologist ruled out rheumatoid arthritis or systemic lupus erythematous. *Id.* at 63; *see also* Pet'r Ex. 16 at 1-4.

Dr. Kinsbourne also observed that petitioner's MRI of his cervical spine was normal and his EMG/NCS study also showed normal nerve conduction of both motor and sensory nerves. Tr. 65. Dr. Kinsbourne stated that "we have a neuropathy which affirmatively is not a long fiber disease like Guillain-Barré…[petitioner] has normal EMG and conduction…which is quite consistent with small fiber neuropathy." Tr. 65. Dr. Kinsbourne explained that "nerve conduction studies and electromyography" are normal in patients with small fiber neuropathy. Pet'r Ex. 30 at 5.

Dr. Kinsbourne testified that as petitioner's disease progressed, his arthralgias and myalgias were no longer present, however, he still complained of "paresthesias and decreased sensation to light touch, cold sensation and hot sensation in a stocking-glove distribution affecting his hands to his elbows bilaterally and affecting his feet and toes up to his knees." Tr. 69. Dr. Kinsbourne stated that this was "classical small fiber neuropathy." *Id.* Dr. Kinsbourne testified that petitioner also had some symptoms in his hips and shoulders, which symptoms are at times described by patients with non-length dependent small fiber neuropathy. Tr. 79. Dr. Kinsbourne testified that petitioner's symptoms of tingling, pins and needles, and sharp-electric shock pains are consistent with what was described in the Hovaguimian article. Tr. 81

The Hovaguimian article explained when diagnosing a patient with small fiber neuropathy, "The history and physical examination findings are still considered the gold standard against which all tests are compared when making a diagnosis of small fiber neuropathy….Generally, if a patient presents with a compelling history for a small fiber neuropathy and an appropriate clinical exam, further testing to confirm the diagnosis may be unnecessary." Pet'r Ex. 66 at 3; Tr. 81. The article also stated that patients with small fiber neuropathy may present with decreased pinprick, decreased thermal sensation, or hyperalgesia in the affected regions. Pet'r Ex. 66 at 2. Quantitative sensory testing ("QST") can assist in the diagnosis of small fiber neuropathy by providing a threshold for detection of thermal sensation, thermal pain, and vibratory sensation. *Id.* Dr. Kinsbourne noted that petitioner had elevated cooling and heat-pain thresholds, which are signals of "deficits for temperature." Pet'r Ex. 45 at 2; Tr. 89. An article by Uceyler et al., filed by respondent, also illustrated that patients with small fiber neuropathy have elevated thresholds for cold, warmth, and temperature changes compared to non-SFN patients. Resp. Ex. A, Tab 7 at 3.[7] In that study, 20 of 22 patients had elevated detection thresholds for all three small fiber functions, cold, warmth and temperature changes. Tr. 97. Dr. Kinsbourne emphasized that petitioner had a positive QST test, meaning that he also experienced higher thresholds for cold and heat. Tr. 98; *see also* Pet'r Ex. 25 at 2. Dr. Kinsbourne testified that the Uceyler article stated, "In the current diagnostic criteria for

[7] N. Uceyler et al., *Elevated Proinflammatory Cytokine Expression in Affected Skin in Small Fiber Neuropathy,* 74 Neuro. 1806-13 (2017). [Resp. Ex. A, Tab 7].

SFN, length-dependent and non-length dependent SFN are not considered separately." He testified that in petitioner had elements of both. Tr. 96.

Dr. Kinsbourne stated that the finding of "some small and medium sized axonal swelling," in petitioner's right distal leg sample was not inconsistent with a diagnosis of small fiber neuropathy. Pet'r Ex. 30 at 4-5. He referenced the Lauria et al. article which states that, "Different studies showed that in some patients, despite persisting positive sensory symptoms, intraepidermal nerve fibers at the distal leg were within normal values." Pet'r Ex. 53 at 1.[8] Lauria assessed the swelling ratio of intraepidermal nerve fibers to the innervation density in a follow-up skin biopsy in patients with painful neuropathy to determine whether axonal swelling was predictive of decreased nerve fiber density. *Id.* The authors found that four of their patients that had persistent burning feet, but a normal IENF density at the first examination, also had increased swelling ratio, but had decreased epidermal innervation density at follow-up. *Id.* at 5. The authors wrote, "The hypothesis that diffuse swellings might represent early evidence of IENF axonopathy was supported by the results of follow-up examination. In fact, all patients showed a decrease in epidermal innervation density at the distal leg, suggesting that swellings preceded the eventual loss of IENF." *Id.* at 5. Dr. Kinsbourne testified that "this is exactly what we think was going on at the time of [petitioner's] biopsy." Tr. 87. Further, the article by Dr. Anne Louise Oaklander stated that while skin biopsies can confirm a diagnosis of small fiber neuropathy, "many laboratories use nonrepresentative or unpublished norms, which leads to inaccurate interpretations because of variability between laboratory methods and reference populations." Pet'r Ex. 67 at 6[9]; Pet'r Ex. 63 at 2. Dr. Kinsbourne testified that the biggest problem with skin biopsies, according to the Oaklander article, is false negatives, and stated that it may be the case with petitioner's biopsy. Tr. 94. He testified that there can be "a clear onset of symptoms of small fiber neuropathy and have nothing visible yet for a time…and only after a lapse of time do the fibers begin to degenerate and then fall out completely." Tr. 95.

Additionally, Dr. Kinsbourne testified on cross-examination that even though Dr. Thaisetthawtkul's interpretation of petitioner's skin biopsy did not confirm the diagnosis of small fiber neuropathy, "many of [Dr. Thaisetthawtkul's] colleagues would not agree that that you can't have small fiber neuropathy unless you have a positive fiber count." Tr. 113. As respondent's counsel noted, the Hovaguimian article states:

> The history and physical examination findings are still considered the gold standard against which all tests are compared when making a diagnosis of small fiber neuropathy. A detailed review of the symptoms, rate of progression, and complaints suggestive of autonomic fiber involvement is necessary. Generally, if a patient presents with a compelling history for a small neuropathy and an appropriate clinical exam, further testing to confirm the diagnosis may be unnecessary.

---

[8] G. Lauria, et al., *Axonal Swellings Predict the Degeneration of Epidermal Nerve Fibers in Painful Neuropathies,* 61 Neuro., 631-36 (2003). [Pet'r Ex. 53].

[9] Oaklander, A. & Nolano, M., *Scientific Advances In and Clinical Approaches to Small-Fiber Polyneuropathy,* JAMA Neurol., doi:10.1001/jamaneurol.2019.2917 (2019). [Pet'r Ex. 67].

Pet'r Ex. 66 at 3; Tr. 116. Dr. Kinsbourne testified that he disagreed with Dr. Thaisetthawtkul's assessment because he only looked at a single test and Dr. Kinsbourne opined that Dr. Thaisettawtkul's conclusion was an "overreach." Tr. 114.

In addition to meeting the diagnostic criteria, Dr. Kinsbourne stated that petitioner had no other competing diagnosis to explain his condition, petitioner's treating physicians also diagnosed him with small fiber neuropathy, and that he was being treated with neuropathic pain medication, consistent with small fiber neuropathy. Pet'r Ex. 45 at 1-5. He noted that Dr. Bobenhouse diagnosed petitioner with "diffuse arm and leg paresthesias/dysesthesias, suspect secondary to small fiber sensory neuropathy in association with the hepatitis vaccine." Pet'r Ex. 43 at 3. Even earlier in petitioner's medical course, rheumatologist, Dr. Chatwell considered the diagnosis of "sensory neuropathy," which would be consistent with small fiber neuropathy. Pet'r Ex. 30 at 2; *see also* Pet'r Ex. 8 at 7. Dr. Kinsbourne stated that despite the skin biopsy not being definitive, petitioner's sensory deficits in appreciating temperature, neuropathic pain, and paresthesias is "characteristic of non-length dependent small fiber neuropathy." Pet'r Ex. 30 at 4. Dr. Kinsbourne testified that the Devigili article, referenced by Dr. Chaudry, demonstrated that 12% of the studied SFN patients were diagnosed by abnormal clinical findings and abnormal QST testing without abnormal skin biopsies and that only 7.5% of patients had abnormal results in all three categories. Tr. 89; Resp't Ex. B, Tab 3 at 9.[10] Dr. Kinsbourne testified that petitioner had both abnormal clinical findings and abnormal QST testing, which fits into the diagnostic criteria for small fiber neuropathy as postulated by the Devigili article. Tr. 90. Dr. Kinsbourne stated that Devigili also explains that abnormal skin biopsy results that show reduced nerve fiber density does not readily explain neuropathic pain. Tr. 90-92. Dr. Kinsbourne also noted that Devilgili authors were unable to establish a significant correlation between nerve fiber density in the lower limbs and the intensity of neuropathic pain because it appears that the cause of pain is not the absence of fibers, but instead the impairment and degeneration of the nerve fibers causing them to "discharge inappropriately." Tr. 89-90; *see also* Resp't Ex. B, Tab 3 at 12.

2. Vaccine causation

Dr. Kinsbourne opined that the Twinrix vaccine that petitioner received on March 18, 2015, was the cause of his small fiber neuropathy. Pet'r Ex. 30, 45, 63; Tr. 105. Dr. Kinsbourne wrote that small fiber neuropathy is similar to Guillain Barré syndrome, which is an immune-mediated disease. Pet'r Ex. 30 at 6; Tr. 101. He acknowledged that there is limited medical literature describing the exact mechanism for the cause of small fiber neuropathy, as it is a rare condition. Pet'r Ex. 30 at 6. However, he also observed that the medical literature indicates that small nerve fibers are "often implicated in GBS," which "creates the presumption that long-fiber GBS and short-fiber small fiber neuropathy are related in their mechanism of causation," albeit, not fully understood. *Id.* Dr. Kinsbourne stated that small fiber neuropathy is an autoimmune disorder, which suggests that there is a diversity of causes for disease, much like GBS. Tr. 103; Pet'r Ex. 30 at 5-8. He stated that because GBS is a "well-known immune-mediated condition that is sometimes caused or triggered by vaccination," and that "autonomic and small fiber neuropathies are often features of GBS…this is evidence that small fiber neuropathy can also be an element of an autoimmune neurological disorder." Pet'r Ex. 30 at 6.

[10] Devigili, G. et al., *The Diagnostic Criteria for Small Fibre Neuropathy: From Symptoms to Neuropathology*, 131 Brain, 1912-1925 (2008). [Resp't Ex. B, Tab 3].

Dr. Kinsbourne proposed that the Twinrix vaccine (hepatitis A and B) caused petitioner's small fiber neuropathy through molecular mimicry. Tr. 94; Pet'r Ex. 30 at 6. In his first report, Dr. Kinsbourne wrote that because "small nerve fibers are implicated in GBS, [this] creates the presumption that long-fiber GBS and short-fiber small fiber neuropathy are related in their mechanism of causation." Pet'r Ex. 30 at 6. He noted that the Oaklander article states that, "Most early-onset SFN is not genetic, but rather appears inflammatory, involving autoreactive B cells." Tr. 93; Pet'r Ex. 67 at 6. The same article also implicates molecular mimicry as a cause of SFN after an HPV vaccination or infection. Pet'r Ex. 67 at 6; Tr. 93. Oaklander explained that with inflammatory small fiber neuropathy that is not associated with a systemic inflammatory disease, it is likely that the autoreactive B cells are using either the classic or lectin pathways of the complement system to cause damage to the small fibers. Pet'r Ex. 67 at 8. The Oaklander article also stated, "We and others have proposed the existence of small fiber targeting inflammatory small fiber neuropathy with acute and chronic presentations temporally resembling Guillain Barré syndrome and chronic inflammatory demyelinating polyneuropathy." *Id.*

Dr. Kinsbourne referred to an article by Seneviratne and Gunasekera, which reported on six patients who fit the diagnosis of "pure sensory variant of Guillain-Barré syndrome with both clinical and electrophysiological features suggestive of small fiber neuropathy." Pet'r Ex. 61.[11] The authors described the six patients as having presented with "acute onset of numbness of the upper and lower limbs," with four having "associated burning dysesthesias in the limbs." *Id.* at 1. None of those patients had muscle weakness, but all had albuminocytological dissociation in CSF, suggestive of GBS. *Id.* The authors concluded that these six patients had small fiber sensory neuropathy because there was selective involvement of small diameter sensory fibers with the relative sparing of the large, myelinated nerve fibers. *Id.* at 3. The authors wrote, "Small fiber involvement in GBS has been shown in a postmortem study, although not in isolation. There is evidence that in peripheral neuropathies, functionally different small fiber systems are affected independently, and selective involvement of different small fiber types is frequent. This study theorizes that in Guillain-Barre syndrome small sensory fibers are a possible target for selective damage by antibodies." *Id.* at 3. Dr. Kinsbourne testified that the Seneviratne study suggests that small sensory fibers are a possible target for selective damage by antibodies both in GBS, but also independently outside of GBS. Tr. 105.

Dr. Kinsbourne also referred to the Martinez et al. article, which investigated the role of small fiber dysfunction in acute neuropathic pain in patients with GBS, to demonstrate that small fibers can also be a target for autoimmune attacks by autoantigens, similar to how large fibers are targeted in GBS. Pet'r Ex. 30 at 6; Tr. 100-01; Pet'r Ex. 71.[12] Martinez stated that "acute neuropathy of GBS not only affects large-myelinated fibers, but also impairs small myelinated and unmyelinated fibers. Small fiber dysfunction seems to be at least partially responsible for neuropathic pain in chronic sensory polyneuropathies…" Pet'r Ex. 71 at 1. Additionally, the

[11] U. Seneviratne & S. Gunasekera, *Acute Small Fiber Sensory Neuropathy: Another Variant of Guillain-Barre Syndrome*? 72 J. Neurol. Neurosurg. Psychiatry, 540-42 (2007). [Pet'r Ex. 61].

[12] Valeria Martinez et al., *Small Fibre Impairment Predicts Neuropathic Pain in Guillain-Barre Syndrome,* 151 Pain, 53-60 (2010). [Pet'r Ex. 71].

authors wrote, "GBS is generally considered to be an acute inflammatory neuropathy that most frequently affects large-diameter fibers. However, a recent study based on skin punch biopsy found reduced values for intraepidermal nerve fiber density in GBS patients with a demyelinating form of the disease that was correlated with abnormal thresholds for warm stimuli, indicating that small fiber neuropathy is also an important manifestation of GBS." *Id.* at 5. Further, they found that small fiber dysfunction was evidenced using quantitative sensory testing which showed impaired detection and pain thresholds for heat and cold stimuli in the foot. *Id.* The authors stated, "[This] data, which are in line with previous observations, adds to a growing body of evidence that acute neuropathy in GBS is not only restricted to large or medium motor or sensory fibers, but also affects small nociceptive fibers to a similar extent." *Id.* Dr. Kinsbourne testified that the Martinez article suggests that "whatever GBS can be triggered by," can also trigger small fiber neuropathy because it is an autoimmune disorder. Tr. 103.

Dr. Kinsbourne opined that the onset of petitioner's initial small fiber neuropathy symptoms was approximately eight days post-vaccination, which is an appropriate timeframe for vaccine-induced autoimmune inflammatory disease, such as small fiber neuropathy. Tr. 98. In the Seneviratne article, four out of the six small fiber neuropathy patients reported a preceding illness that occurred three days to 1.5 months before onset of the first symptoms of their disease. Pet'r Ex. 61 at 1. One patient reported having a gastrointestinal illness three weeks before onset of initial symptoms, while another had a urinary tract infection one week prior to the onset of the numbness and burning sensations in the feet. *Id.* Further, Dr. Gobbo, one of petitioner's treating physicians, noted the temporal association between the onset of petitioner's symptoms and the Twinrix vaccine, stating, "The temporal relation of [petitioner's] symptoms, especially the fatigue and arthralgias, shortly after the Twinrix vaccination, suggests an idiosyncratic reaction to the vaccine as the most likely cause of his problems." Pet'r Ex. 18 at 1.

Dr. Kinsbourne further observed that many of petitioner's treating physicians also attributed the onset of petitioner's symptoms to his receiving the Twinrix vaccine. When petitioner was initially hospitalized on March 27, 2015, Dr. Gobbo's impression was that petitioner had a "vaccine reaction to the Twinrix causing a serum-sickness type reaction which manifests mainly as polyarthralgia and severe fatigue." Pet'r Ex. 7 at 3. When petitioner was hospitalized from April 7-8, 2015, rheumatologist, Dr. Chatwell assessed petitioner with "migratory severe polyarthralgia" and wrote, "Differential diagnosis includes a reactive phenomenon such as a post-vaccination? Or post viral etiology. The patient lacks fevers or skin rash to suggest adult-onset of Still disease and his current clinical presentation is not suggestive of a rheumatoid arthritis, systemic lupus erythematous, etc. No obvious preceding infection has been defined." Pet'r Ex. 8 at 7. Dr. Chatwell also considered "sensory neuropathy" as a diagnosis for petitioner. *Id.* After petitioner's April 2015 hospitalization, Dr. Gobbo wrote, "At this point, there is no obvious infectious cause or contributor to [petitioner's] symptoms. Adverse vaccine reaction remains the most plausible cause, though I would still wonder about possible seronegative type of autoimmune disease." Pet'r Ex. 18 at 20. One year later, March 29, 2016, Dr. Bertolini diagnosed petitioner with "Post-hepatitis A and B vaccine reaction with persistent numbness and tingling of his arms and legs with stocking glove distribution bilaterally of legs, arms, hands, and feet." Pet'r Ex. 14 at 19.

During cross-examination, Dr. Kinsbourne also observed that petitioner did not have any underlying other conditions that could have given rise to small fiber neuropathy, such as diabetes, vasculitis, lupus or Sjogren's syndrome. Tr. 118-19. He acknowledged that none of petitioner's treating physicians came to a "firm" conclusion that petitioner had small fiber neuropathy, but "they all concluded the vaccine caused," something in petitioner. *Id.* at 120.

In summary, Dr. Kinsbourne opined that petitioner's small fiber neuropathy was caused by the Twinrix vaccine petitioner received. He stated that "no viable competing diagnoses have been proposed, the temporal period from vaccine to onset is appropriate and no alternative causation is in evidence." Pet. Ex. 45 at 5; Tr. 104-05.

c. Respondent's expert, Dr. Vinay Chaudhry

1. Petitioner's diagnosis

Dr. Chaudhry opined that petitioner did not have small fiber neuropathy or any form of peripheral neuropathy. Resp. Ex. A at 7; Resp. Ex. B at 6; Tr. 187.

In his first report, Dr. Chaudry stated that he did not believe that petitioner's symptoms could be explained by a neurologic or neuromuscular condition because: a) petitioner's symptoms were inconsistent with peripheral neuropathy; b) petitioner had normal neurological examinations; c) petitioner had normal EMG/NCS studies; d) petitioner's skin biopsy revealed normal fiber density; e) petitioner had a normal autonomic function test assessed by Quantitative sudomotor axons reflex test ("QSART"); and f) none of petitioner's treating neurologists diagnosed petitioner with peripheral neuropathy. Resp. Ex. A at 6-7. Dr. Chaudry also wrote a second expert report, after petitioner had filed additional records from Dr. Bobenhouse and updated records from Dr. Gobo. Resp. Ex. B. After reviewing petitioner's updated records, Dr. Chaudry explained that his opinion regarding petitioner's diagnosis was not changed. *Id.* at 6. He stated that Dr. Bobenhouse's assessment of petitioner included "several inconsistencies," and that Dr. Bobenhouse's diagnosis of "suspected small fiber neuropathy," was not supported by the history, examination findings of petitioner, or the EMG/NCS. *Id.*

With respect to petitioner's presenting symptoms, Dr. Chaudry opined that petitioner's initial complaints of myalgias in his shoulders and arthralgias of the hip joints, in addition to petitioner having no sensory deficits, on March 25, 2016, are inconsistent with any type of neuropathy. Tr. 132; Resp. Ex. A at 6. He stated that petitioner's symptom complaints in the emergency department on March 26th are also unrelated to neuropathy. Tr. 133. Dr. Chaudry testified that in the record on March 26th that there was "no mention of sensory loss, no mention of the paresthesias, the tingling, the numbness, the burning that you see in small fiber neuropathy….no one even raised that possibility." *Id.*

Dr. Chaudry testified that when petitioner sought treatment with Dr. Bertolini on April 3, 2015, he was endorsing some neuropathic symptoms, including bilateral paresthesias, but that those symptoms were "difficult to dissect out," because he was presenting with other symptoms such as bilateral hip and shoulder pain. Tr. 137. Additionally, Dr. Chaudry argued that Dr. Bertolini's sensory examination did not show any abnormalities. *Id.* Dr. Chaudry stated, "…the

fact that [petitioner's] symptoms are more related to the joint pains, the fact that there's no sensory deficit on examination, that suggests that there was no significant neuropathy, at least at this stage." Tr. 138. Dr. Chaudry acknowledged that petitioner reported "tingling in his feet" at the April 3, 2015 appointment, however, he downplayed the relevance of tingling by characterizing them as "nonspecific," and not supported by the sensory examination. *Id.*

Additionally, Dr. Chaudry argued that when petitioner was first evaluated by a neurologist, Dr. Nair, on April 7, 2015, the consultation was for "polyarthralgia and fatigue post-vaccination," which are not symptoms of neuropathy. Tr. 139; *see* Pet'r Ex. 9 at 1. At this appointment, petitioner's sensory examination noted that he had some abnormalities to perceiving pinprick over the dorsum of the hands, distal forearms, and the dorsum of his feet and he had decreased sensation to vibration over his knuckles and toes. Pet'r Ex. 9 at 2. Dr. Chaudry stated that the examination "appears to show patchy sensation loss to pin[prick] over the dorsum of the hands, forearms, and feet, and the vibration was diminished," but that these sensory deficits "are not part of small fiber neuropathies." Tr. 140. He testified that vibration sense loss is not part of small fiber neuropathy and that loss of pinprick sensation in the pattern on petitioner's knuckles and toes was "not typical for small fiber neuropathy." *Id.* He testified that "small fiber neuropathy has different sizes [of nerves affected] small, medium, and large and the larger ones are more motor controlling and vibration controlling, whereas the smaller ones control more burning, tingling sensation and pinprick, and temperature sensibility." Tr. 141. He stated that a finding of reduced pinprick and vibration sensation is not part of small fiber modality. *Id.*

When Dr. Chaudry reviewed petitioner's appointment from April 17, 2015 with Dr. Bertolini, he skipped over the rather detailed "History of Present Illness" in the medical record, which stated that petitioner had temperature changes in his skin, in addition to "problems with numbness of his arms and legs." Pet'r Ex. 14 at 91. The physical examination from this appointment demonstrated that petitioner had "some numbness of his arms and hands," and "numbness of his distal legs, anterior calf area bilaterally." *Id.* at 93. Dr. Chaudry did not mention these notations from Dr. Bertolini, nor did he acknowledge that Dr. Bertolini added "disturbance of skin sensation" to petitioner's list of diagnoses. *See* Pet'r Ex. 14 at 94. Dr. Bertolini diagnosed petitioner with, "Problems with poly-arthralgias and numbness with paresthesia of his upper and lower extremities with severe fatigue secondary to reaction from hepatitis A and B vaccine." *Id.*

Dr. Chaudry then discussed petitioner's appointment with neurologist Dr. Sundell on May 1, 2015, and stated, "[Petitioner's] reflexes are intact. [Dr. Sundell] says that there is diminished pinprick on the dorsal surface of the forearm. This is not now on the wrist as it was before, and diminished pinprick on the volar surface. He feels fairly well, but vibration was better than before, but I guess it was still reduced." Tr. 142. The note from the actual medical record provides that petitioner had diminished pinprick on the dorsal surface of his forearm, but "on the volar surface he feels this fairly well." Pet'r Ex. 24 at 1. Dr. Chaudry notes that Dr. Sundell wrote that he "cannot find a definite neurological cause for his subjective sensory symptoms," and pointed to this as evidence that petitioner was not suffering from peripheral neuropathy. Resp. Ex. A at 7; Tr. 142.

When Dr. Chaudry reviewed petitioner's medical record from September 4, 2015, another appointment with Dr. Bertolini, he acknowledged that petitioner's sensory symptoms of "paresthesias and decreased sensation to light touch, cold sensation, and hot sensation diminished in a stocking glove distribution affecting his hands to his elbow bilaterally and affecting his feet and toes up to his knees," are consistent with small fiber neuropathy. Tr. 144; *see also* Pet'r Ex. 14 at 57. He also stated that petitioner's sensory examination, which showed "abnormal sensation to light touch; decreased sensation to light touch and pinprick at the hands and feet in a stocking glove pattern," is also consistent with small fiber neuropathy. Dr. Chaudry argued that at the appointment on March 29, 2016, however, petitioner's reports of pain are only in the joints, like the wrist and arm, are "not the typical pain you would see for a small fiber neuropathy patient, which is more burning, tingling, don't allow anyone to touch." Tr. 145. He also stated that petitioner's examination only showed decreased sensation to light touch in his lower extremities and "there's no mention of the pinprick loss in the lower extremities." *Id.* He stated petitioner's examination was "not showing the typical, stocking [distribution]." *Id.* In Dr. Chaudry's opinion, this is additional evidence that petitioner did not have small fiber neuropathy. However, he failed to include Dr. Bertolini's assessment of petitioner from the March 29, 2016 appointment which provided, "Post-hepatitis A and B vaccine reaction with persistent numbness and tingling of his arm and legs *with stocking glove distribution of legs, arms, hands, and feet."* Pet'r Ex. 14 at 17 (emphasis added).

Dr. Chaudry testified that petitioner's normal QSART test, performed by neurologist, Dr. Thai, excludes large fiber neuropathy, small fiber neuropathy, and autonomic neuropathy. Resp. Ex. A at 7; Tr. 148-50. He stated that petitioner's heart rate response to deep breathing and Valsalva, blood pressure and heart rate response to a 70-degree tilt were all normal. Resp. Ex. A at 7; Tr. 147. Additionally, petitioner's QSART showed normal sweat output at the left forearm, leg, and foot. *See* Pet'r Ex. 25 at 2. Dr. Chaudry stated that the autonomic fibers are all small fibers and the results of the QSART test confirm that petitioner did not have any small fiber disturbances. Tr. 150. While Dr. Chaudry acknowledged that petitioner's QST test showed "mixed short elevated vibratory cooling and heat pain thresholds, he asserted that these findings were "non-specific," and that the QST test is not an objective test, and there is a degree of subjectivity. Tr. 148. Furthermore, Dr. Chaudry testified that even with the QST test showing "elevated vibratory, cooling, and heat-pain thresholds," Dr. Thai "did not think that [the QST testing results] was significant." Tr. 149. Dr. Chaudry agreed with Dr. Thaisetthawatkul's assessment that "there [was] no evidence from electrophysiological studies to indicate a neuromuscular cause for [petitioner's] symptoms." Tr. 150.

After concluding that there was no evidence of large fiber neuropathy, Dr. Thaisetthawakul ordered a skin biopsy. Pet'r Ex. 25 at 2. Dr. Chaudry opined that petitioner's skin biopsy was normal and showed "no clear pathological evidence of small fiber neuropathy." Tr. 153. He stated that petitioner's skin biopsy showed normal epidermal fiber densities at 11.1, with the lower limit of normal being 5.2 fibers per millimeter. Tr. 151. He also stated that petitioner's epidermal fiber at the right proximal thigh was also normal, at 28.3, with normal being more than 8 per millimeter. *Id.*; *see also* Pet'r Ex. 22 at 7. Dr. Chaudhry testified that "there was no meaning" to the finding of "small and medium axonal swelling." Tr. 152. He stated that, "If there was any meaning to that, Dr. Herrmann [pathologist] would put that in his report." *Id.* Dr. Chaudry also stated that if petitioner had non-length dependent neuropathy, then

the small-and medium sized axonal swelling finding would have been present in both skin samples, not just in the ankle sample. Tr. 152. He testified that Dr. Herrmann, a small fiber expert at the University of Rochester, made a "black and white" interpretation of petitioner's skin biopsy, stating that there was "no clear pathologic evidence of small fiber neuropathy based on epidermal nerve fiber densities at the distal leg and proximal thigh." Tr. 153 (citing Pet'r Ex. 22 at 7).

Dr. Chaudry also testified as to the finding of small and medium axonal swelling on the biopsy if the fiber density is normal, then the swelling is not something to "worry about." Tr. 176. He stated that with skin biopsies, if the fiber density is abnormal and shows a reduction, it's a length dependent process. *Id.* If there is reduced fiber density at the lower leg and a finding of axonal swelling in the upper thigh biopsy, then some people think it may be a precursor [of large fiber neuropathy]." *Id.* He testified that Dr. Herrmann "did not make much of the swellings," and neither did Dr. Thaisetthawakul, and that he has no reason to "disbelieve" their interpretation. Tr. 177.

Dr. Chaudry testified that Dr. Thaisetthawakul also interpreted petitioner's skin biopsy results as "normal." Tr. 154; *see* Pet'r Ex. 22 at 1. Dr. Chaudry stated that there was no reason to doubt Dr. Thaisetthawakul's diagnosis and assessment of petitioner. Tr. 155. Dr. Chaudry testified that four neurologists prior to Dr. Bobenhouse had provided their opinion about various aspects of petitioner's case. Tr. 165. He testified, "Dr. Nair, Dr. Sundell, Dr. Franco who just did the EMG, Dr. Thai, and Dr. Herrmann who interpreted the biopsy. None of them had questions, even though they considered [small fiber neuropathy]….But they were doing tests to see whether they could find [small fiber neuropathy], and they ran all the way out to do QSTs, to do autonomic testing, to do the examinations, to do skin biopsies. And yet they said no, this is not small fiber neuropathy." Tr. 165; *see also* Resp. Ex. A at 2-3.

Dr. Chaudry noted that petitioner saw Dr. Bobenhouse three years after the Twinrix vaccination and after petitioner had seen other very highly qualified neurologists. Resp. Ex. B at 2-4. He stated that petitioner's medical history of disorientation, weakness, headaches, pain in the hips, knees, shoulders, and elbows are not features of small fiber neuropathy. *Id.* at 4; Tr. 160. Dr. Chaudry testified that petitioner's report of weakness and diffuse pain, which worsened with exertion was also not consistent with small fiber neuropathy. Tr. 159. He stated that "small fiber neuropathy is not exertion-related." *Id.* Again, Dr. Chaudry skipped petitioner's reports of "paresthesias and dysesthesias in the feet and forelegs as well as in the hands and forearms," and testified that petitioner's reports of knife-like pain in his hips, knees, and shoulders are joint-related issues not seen in small fiber neuropathy. Tr. 160. When Dr. Chaudry reviewed Dr. Bobenhouse's physical examination of the petitioner on May 11, 2018, he stated that the findings of decreased sensitivity to light touch in the legs and hands are "not part of small fiber neuropathy." Tr. 161. He testified that petitioner's decreased sensitivity to pinprick found in his legs, feet, and hands, however, could be related to small fiber neuropathy. *Id.* Dr. Chaudry also testified that petitioner's reduced or absent reflexes, and the sensory level over the abdomen below the T8 level are all "not part of small fiber neuropathy." Tr. 162. Referencing Dr. Bobenhouse's assessment of petitioner, Dr. Chaudry stated:

> ….the fact of the [decreased sensitivity to] light touch, the fact that the reflexes are absent, the fact that the sensory level is present, the fact that the common peroneal motor response is low, the fact that the symptoms are predominantly all related to this knife-like sensation in his hips, knees, shoulders and elbows, clearly to me…as a clinical person, with or without the skin biopsy, does not show this is small fiber neuropathy.

Tr. 163.

Dr. Chaudry testified that the "typical symptoms" he considers related to small fiber neuropathy as "dysesthesias or allodynia" where a patient describes the pain as superficial, or burning. Tr. 171. Tingling or electrical shocks can also be features of small fiber neuropathy. *Id.* The symptoms occur in a "somewhat length-dependent pattern," that starts in the toes, then goes to the middle of the foot and the sole is more affected than the dorsum of the foot. *Id.* Then the symptoms move to the ankle and by the time these symptoms occur at the ankle, patients may have similar feelings in the tips of their fingers. *Id.* He stated that "depending on when you see the patient, [the symptoms] might be ascending up to…the mid-leg or up to the mid-palm." *Id.* Strength and gait are typically recorded as normal and patients do not generally have bladder or bowel issues. *Id.* Dr. Chaudry testified that when examining patients with these symptoms you use a pin and "even though they are complaining of pain, they'll have reduced pinprick sensibility as you move up from the toes, up to the foot to the ankle, and then it becomes normal somewhere in the calf." *Id.* Furthermore, vibration sensation is normal, because that is a "large fiber modality," and reflexes, joint position, and strength are normal because they are all large fiber sensibilities. Tr. 172. He testified that one of the large fiber modalities may be abnormal and that if someone presented with "severe burning, tingling in a length-depended fashion, has pinprick loss, temperature distal loss, and also may have mild vibration loss, well it may be that [the neuropathy] has progressed to more large fibers." *Id.*

Dr. Chaudry was asked by the Court to explain why decreased sensation to light touch was not part of small fiber neuropathy. Tr. 195. He testified that light touch was "carried by different fibers" and that small fiber and a-delta only carry pinprick, warm and cold temperature, but not light touch. Tr. 196. He also testified that the loss of vibratory sensation is also associated with the loss of large fiber involvement and that it can occur in the context of someone who has small fiber neuropathy that has evolved to include involvement of the large nerve fibers. Tr. 196. He stated that if petitioner's presentation began with "burning, tingling, started in his feet, ascended up and over a period of time, his only abnormality was initially just temperature. Years passed. Then it's vibration and proprioception loss….He has nerve conduction study abnormality….[Y]ou'd say the predominant manifestation is small fiber. Skin biopsy is abnormal. But he also has mild vibration abnormality. That means the disease has progressed, because some of the neuropathy…do not restrict themselves to small fibers." Tr. 196-97. However, absent vibration in the knuckles is not something to expect without the other typical symptomatology and with a normal skin biopsy. Tr. 197.

Dr. Chaudry testified that petitioner's symptoms of joint pain, the fluctuations of the sensory examinations, memory loss, dizziness and walking trouble, weakness and fatigue are all inconsistent with small fiber neuropathy. Tr. 172. He stated, "Now, it's said that maybe he had two diseases. [He] had something else…in the beginning and it evolved into something else.

Again, I don't know what that something else is. If you can give me that diagnosis of something else, maybe I'll say, can it cause this too. But clinically, as an expert asked to address whether this is small fiber neuropathy….I can unequivocally say this is not, not in my experience….and this is not the presentation I've seen." Tr. 173. When Dr. Chaudry was asked by the Court whether petitioner's abnormal reflex findings later in petitioner's course of treatment, combined with the normal EMG finding by Dr. Bobenhouse, was consistent with the evolution of small fiber neuropathy, Dr. Chaudry responded that he was not aware of that's how [small fiber neuropathy evolves.]. He stated that "you don't just lose reflexes without strength being abnormal….because generally large fibers are affected." Tr. 200.

During the hearing, Dr. Chaudry was asked whether petitioner's symptoms would be consistent with non-length dependent SFN, as described in the Gemignani et al. article, which studied non-length dependent SFN and assessed its features in comparison with the distal form of SFN. Tr. 201-03. Gemignani found that "that non-length dependent SFN is under recognized in the general population, as a consequence of its unusual presentation." Pet'r Ex. 33 at 3. The article noted that sensory symptom regional distribution varied from the traditional "stocking-glove," distribution to also included positive sensory disturbances on the chest, upper legs, and face. *Id.* at 3. Dr. Chaudry said most of the patients in the Gemignani study had allodynia, something that the petitioner did not have, and all the patients also had abnormal skin biopsies. Tr. 203. Dr. Chaudry also stated that patients in the Gemignani article all had normal reflexes and normal strength, and they described "normal" small fiber neuropathy symptoms, such as burning and reported discomfort or pain to light touch. *Id.* Dr. Chaudry conceded that some of petitioner's medical records endorsed a stocking-glove distribution of sensory changes, however, they also included joint pain, "that's not the type of pain you're talking about in non-length dependent [small fiber neuropathy]." *Id.* He implied that it is not enough to make a diagnosis of small fiber neuropathy based on one part of the petitioner's presentation, but that Dr. Thaisetthawakul looked at multiple tests and made "a very categorical statement. Surely there is no large or small fiber neuropathy." *Id.* (citing Pet'r Ex. 22 at 1).

Finally, regarding petitioner's diagnosis, Dr. Chaudry stated that a diagnosis of small fiber neuropathy is not made because certain medications work. Tr. 178. He testified that the medications that petitioner had been treated with, including Lyrica, Cymbalta, and Topamax are used to treat fibromyalgia, neuropathic pain, or joint and muscle pain. *Id.* He stated that petitioner's treating physicians were attempting to treat petitioner's symptoms. *Id.* Dr. Chaudry testified that the medications petitioner was treated with are also prescribed by rheumatologists or orthopedists, but that does not mean the patients have small fiber neuropathy. Tr. 179. Dr. Chaudry stated that petitioner was given several pain medications, but it has no relevance to petitioner's diagnosis *per se*. *Id.*

Dr. Chaudry concluded his testimony, reiterating that petitioner did not have small fiber neuropathy in his opinion and that the treating neurologists petitioner saw prior to seeing Dr. Bobenhouse conducted thorough evaluations of the petitioner and were unable to diagnose petitioner with small fiber neuropathy. Tr. 192; *see also* Resp. Ex. B at 2. He acknowledged that petitioner did have some type of "acute reaction with joint pains and sometimes abnormal liver function tests and CRP," but he could not characterize petitioner's condition as small fiber neuropathy. Tr. 204-05. He opined that petitioner's condition "somewhat fit" the description of

fibromyalgia, based on petitioner's predominant symptom of joint pain. Tr. 204. He stated that arthralgias is a description of pain in the fibrous tissues around the joints. *Id.* But Dr. Chaudry testified that nobody has indicated that myalgias or arthralgias are symptoms of small fiber neuropathy. Tr. 205.

2. Vaccine causation

Dr. Chaudry opined that the Twinrix vaccine was not the cause of petitioner's symptoms or condition. Resp. Ex. A at 13; Tr. 180-84.

Dr. Chaundry contended that small fiber neuropathy is not an autoimmune condition, and that small fiber neuropathy is not similar to Guillain-Barré syndrome, therefore, there is no reliable evidence that small fiber neuropathy could be triggered by the same mechanisms as GBS. Tr. 181; *see also* Resp. Ex. A at 13. He testified that GBS is an attack on the myelin sheath and that myelin is only present on large fibers, not smaller fibers. Tr. 180. In his expert report, Dr. Chaudry stated that the Pan article, which explored small fiber neuropathy in patients with GBS, is irrelevant to the petitioner's case because the petitioner did not have diagnosed GBS. Resp. Ex. A at 12. He stated that in Pan "patients had to fulfill the diagnostic criteria of demyelinating GBS," and that petitioner had none of the features of GBS, including symmetrical distal-predominant limb weakness, generalized areflexia or hyporeflexia, or electrophysiological evidence of acquired demyelination on nerve conduction studies. *Id.* He also stated that the skin biopsy of the patients from the Pan article showed "reduced epidermal nerve density, or varicosity, or fragmented appearance," while petitioner's biopsy did not display those features. *Id.* The Pan article explained that their results "indicate that cutaneous innervation is diminished in acute monophasic polyneuropathy of inflammatory or immune-mediate etiology." Pet. Ex. 39 at 12.[13] Further, Pan concluded that their findings "suggest that small fiber sensory neuropathy is also an important manifestation of GBS, and that GBS should be considered a global neuropathy instead of a pure large-fiber neuropathy." *Id.* Dr. Chaudry stated that some patients with GBS can experience pain, but that "does not make it small fiber neuropathy." Tr. 181.

Dr. Chaudry also stated that the Martinez article, which explored the mechanism of neuropathic pain in GBS, was also not relevant to the case because petitioner did not have neuropathic pain or GBS. Resp. Ex. A at 12. As discussed above, the Martinez article suggested that small fiber neuropathy is also "an important manifestation of GBS," and that the study, along with others, "adds to the growing body of evidence that acute neuropathy in GBS is not only restricted to large or medium motor and sensory fibers, but also affects nociceptive fibers to a similar extent." Pet'r Ex. 71 at 5. While being questioned by the Court, Dr. Chaudry conceded that there can be "large fiber involvement…sometimes in small fiber patients," but that is typically paired with the typical symptomology that continues to progress over time. Tr. 196.

Dr. Chaudry testified that certain infections, including *campylobacter jejuni*, respiratory tract infections, influenza, COVID infection, and hepatitis E infections, have all been associated with GBS. Tr. 183. He stated that molecular mimicry is the "most obvious" hypothesis for how *c.jejuni* can result in GBS. *Id.* However, he stated that "nobody has ever shown" that molecular

[13] Chun-Ling Pan et al., *Cutaneous innervation in Guillain-Barre syndrome: Pathology and Clinical Correlations,* 126 Brain 386-97 (2003). [Pet. Ex. 39].

mimicry is the cause of small fiber neuropathy. Tr. 181. He testified that the "immune hypothesis" that Dr. Kinsbourne referred to as the underlying cause of small fiber neuropathy, was from the Oaklander article, which was focused on children, not adults. Tr. 181. He noted that Oaklander found that "Most early-onset SFN is not genetic but rather appears to be inflammatory, involving autoreactive B cells," but that Professor Oakland was referring to small fiber neuropathy in people under the age of 21. *Id.*; *see also* Pet'r Ex. 67 at 6. On review of the article, Dr. Oaklander stated s, "Autoantibodies have been associated with dysautonomic SFN symptoms, including POTS, and corticosteroid immunotherapy has effectively treated young patients with rapid-onset painful SFN. Pet'r Ex. 67 at 6. The article goes on to state, "Reports of early onset SFN after infectious exposures, particularly to human papillomavirus vaccination, suggest potential for molecular mimicry. *Autoreactive SFN also affects adults* but is easiest to diagnose in children and otherwise healthy young people without other risk factors." *Id.* at 6 (emphasis added).

Dr. Chaudry also disagreed with Dr. Kinsbourne's theory that small fiber neuropathy may be caused by an inflammatory process. Tr 185; Resp. Ex. A at 11. In his report, Dr. Chaudry stated that the Lacomis article "clearly notes the cause of small fiber neuropathy is rarely found and when found, it is usually diabetes mellitus." Resp. Ex. A at 11; *see also* Pet'r Ex. 35 at 10.[14] Dr. Chaudry, citing Lacomis, wrote, "Idiopathic small-fiber neuropathy is the diagnosis in 93% of the cases." Resp. Ex. A at 11. He also wrote that the "inflammatory basis" hypothesis as a cause of small fiber neuropathy was based on circumstantial evidence from one patient with vasculitis, Lupus, or Sjogren's syndrome. *Id.* However, Lacomis did not just examine one patient case in whom an inflammatory or autoimmune process was considered as a cause of small fiber neuropathy, but instead identified multiple articles where an immune-mediated etiology had been considered. Lacomis wrote:

> In some patients with idiopathic small-fiber neuropathy, an *inflammatory autoimmune* basis has been hypothesized and circumstantial evidence is available. Sural nerve biopsy specimens from 12 patients with clinical feature of small-fiber neuropathy, including burning feet, revealed multifocal axon loss in 5 and epineurial perivascular lymphocytes in all. This inflammation was deemed "significant" in seven.

Id. at 10 (original emphasis). Further, Lacomis cited an article by Seneviratne and Gunasekera which reported on six patients with "acute onset of small fiber neuropathy" four of which had an antecedent illness; an article by Giuliani et al., which identified 39 patients of small fiber neuropathy, 15 of which had evidence suggestive of an autoimmune disposition; and Suarez et al, which "also postulated an immune mediated mechanism in idiopathic autonomic neuropathies that followed a viral illness." *Id.*

Dr. Chaudry testified that there are no known infectious causes of small fiber neuropathy, but the most common cause is diabetes or glucose intolerance. Tr. 184. He stated that "even a metabolic syndrome, obesity with high triglycerides and hypertension….can also lead to small fiber neuropathy." *Id.* He also suggested that taking too much B6 could result in small fiber neuropathy, along with other heredity conditions, but that "diabetes or glucose intolerance," are the most likely known causes. Tr. 185. However, he acknowledged that in about 90 percent of

[14] Lacomis, David, *Small-Fiber Neuropathy*, 26 Muscle Nerve 173-188 (2002). [Pet'r Ex. 35].

cases no cause of small fiber neuropathy was found and labeled as "idiopathic." *Id.* Dr. Chaudry stated that he was not aware of hepatitis A or B infection being associated with small fiber neuropathy. *Id.* He also testified there was no known association between the hepatitis B vaccine and GBS. Tr. 195. He acknowledged that "there may be case reports, but it's not one of the associated links." *Id.*

Dr. Chaudry testified that if petitioner had an autoimmune condition that was caused by a vaccine, the onset eight days after vaccination would be an acceptable timeframe. Tr. 188. Dr. Chaudry asserted that petitioner was not exhibiting any symptoms of small fiber neuropathy eight days after vaccination. *Id.* However, he acknowledged that petitioner became "much more functionally disabled after the vaccine." Tr. 208.

IV. Applicable Law

The Vaccine Act was established to compensate vaccine-related injuries and deaths. Section 10(a). "Congress designed the Vaccine Program to supplement the state law civil tort system as a simple, fair and expeditious means for compensating vaccine-related injured persons. The Program was established to award 'vaccine-injured persons quickly, easily, and with certainty and generosity.'" *Rooks v. Sec'y of Health & Human Servs.,* 35 Fed. Cl. 1, 7 (1996) (quoting H.R. No. 908 at 3, *reprinted in* 1986 U.S.C.C.A.N. at 6287, 6344).

A petitioner bears the burden of establishing his or her entitlement to compensation from the Vaccine Program. The burden of proof is by a preponderance of the evidence. Section 13(a)(1).

A. Nature of Injury

The Federal Circuit established the test for actual causation of an off-Table injury in *Althen*, 418 F.3d at 1278. In that case: "There was no dispute as to whether the petitioner, Margaret Althen, actually suffered from a central nervous system demyelinating disorder. Therefore, the Federal Circuit was not presented with a case in which the diagnosis itself was questioned, but one in which causation of the injury by the vaccine was the issue in dispute." *Doe v. Sec'y of Health & Hum. Servs.*, 94 Fed. Cl. 597, 611 (2010) (citing *Althen*, 418 F.3d at 1282), *aff'd, Lombardi v. Sec'y of Health & Hum. Servs.*, 656 F.3d 1343 (Fed. Cir. 2011).

Special masters are generally not tasked with diagnosing injuries. In *Lombardi*, the Federal Circuit explained: "The function of a special master is not to 'diagnose' vaccine-related injuries, but instead to determine 'based on the record evidence as a whole and the totality of the case, whether it has been shown by a preponderance of the evidence that a vaccine caused the petitioner's injury.'" *Lombardi*, 656 F.3d at 1343, *citing Andreu v. Sec'y of Health & Hum. Servs.*, 569 F.3d 1367, 1382 (Fed. Cir. 2009).

However, the Federal Circuit has determined that in certain instances, "if there is a dispute as to the nature of a petitioner's injury, the special master may opine on the nature of the petitioner's injury." *Contreras v. Sec'y of Health & Hum. Servs.*, 844 F.3d 1363, 1368 (Fed. Cir. 2017), *citing Hibbard v. Sec'y of Health & Hum. Servs.*, 698 F.3d 1355 (Fed. Cir. 2012); *see also*

Locane v. Sec'y of Health & Hum. Servs., 686 F.3d 1375 (Fed. Cir. 2012); *Broekelschen v. Sec'y of Health & Hum. Servs.*, 618 F.3d 1339 (Fed. Cir. 2010)).

In *Hibbard*, the Federal Circuit reasoned: "If a special master can determine that a petitioner did not suffer the injury that she claims was caused by the vaccine, there is no reason why the special master should be required to undertake and answer the separate (and frequently more difficult) question whether there is a medical theory, supported by 'reputable medical or scientific explanation,' by which a vaccine can cause the kind of injury that the petitioner claims to have suffered." 698 F.3d at 1365.

While the special master is not required to reach a specific diagnosis, the special master may appropriately evaluate at least the nature of petitioner's injury and whether that aligns with petitioner's theory. For example, in *Broekelschen*, the petitioner posited "transverse myelitis [which] is an inflammatory event caused by an immune response," while the respondent posited "anterior spinal artery syndrome, [which] is a vascular event caused by a blockage." 618 F.3d at 1346. The Federal Circuit observed: "Nearly all of the evidence on causation was dependent on the diagnosis" and because the injury itself [was] in dispute, the proposed injuries differ[ed] significantly in their pathology, and the question of causation turn[ed] on which injury [the petitioner] suffered." *Id.* Accordingly, the Federal Circuit held "it was appropriate… for the special master to first determine which injury was best supported by the evidence presented in the record before applying the *Althen* test so that the special master could subsequently determine causation relative to the injury." *Id.*

In contrast, in *Contreras*, the Court of Federal Claims held that the special master erred by diagnosing the petitioner's illness – as TM and not Guillain-Barré syndrome ("GBS") – before evaluating the *Althen* prongs. 107 Fed. Cl. 280, 292-93. The Court reasoned that the case contained "ample evidence that TM and GBS are similar diseases with similar pathologies" and the parties' "unified position [was] that an exact diagnosis of [the petitioner's illness] was not required to rule on causation." *Id.* at 293. The Court of Federal Claims articulated that "the general rule is that the special master should not conduct a differential diagnosis, at the outset of the causation analysis, to choose one diagnosis over another, or over a combination of diagnoses." *Id.*, *aff'd* 844 F.3d 1363; *see also Andreu*, 569 F.3d 1367, 1378 (holding that the special master need not determine whether an initial seizure was febrile or afebrile for purposes of assessing vaccine causation).

Relevant to this inquiry, the Vaccine Act provides that a special master must consider the record as a whole including any medical diagnosis contained therein. Section 300aa-13(b)(1). However, no diagnosis in the medical records is "binding on the special master." *Id.* Rather, "[i]n evaluating the weight to be afforded to any such diagnosis… the special master… shall consider the entire record and the course of the injury, disability, illness, or condition until the date of the judgment of the special master." *Id.* The special master shall also consider any expert opinions and additional medical scientific evidence in the record. *Id.*

B. Causation

A petitioner may prevail by proving either that (1) the vaccinee suffered an injury listed

on the Vaccine Injury Table with onset beginning within a corresponding time period following receipt of a corresponding vaccine (a "Table Injury"), for which causation is presumed or that (2) the vaccinee suffered an injury that was actually caused by a vaccine. Under either method, however, the petitioner must also show that the vaccinee "suffered the residual effects or complications of the illness, disability, injury, or condition for more than six months after the administration of the vaccine." Section 11(c)(1)(D)(i).

In the present case, petitioner does not and cannot allege a Table injury. Thus, he bears the burden of establishing actual causation. To do so, he must "show by preponderant evidence that the vaccination brought about the injury by providing 1) a medical theory connecting the vaccination and injury; 2) a logical sequence of cause and effect showing that the vaccination was the reason for the injury; and 3) a showing of proximate temporal relationship between vaccination and injury." *Althen v. Sec'y of Health & Human Servs.,* 418 F. 3d 1274, 1278 (Fed. Cir. 2005). There must be preponderant evidence for each *Althen* prong. *Caves v. Sec'y of Health & Human Servs.*, 100 Fed. Cl. 119, 132 (2011), *aff. per curiam,* 463 Fed. Appx. 932 (Fed. Cir. 2012).

Under *Althen* prong one, the causation theory must relate to the injury alleged. Thus, a petitioner must provide a "reputable" medical or scientific explanation that the vaccine received *can cause* the type of injury alleged. *Pafford*, 451 F.3d at 1355-56. The theory must be based on a "sound and reliable medical or scientific explanation." *Knudsen*, 35 F.3d at 548. It must only be "legally probable, not medically or scientifically certain." *Id.* at 549. However, the theory still must be based on a "sound and reliable medical or scientific explanation." *Id.* at 548. The Federal Circuit explained in *Althen* that "while [that petitioner's claim] involves the possible link between [tetanus toxoid] vaccination and central nervous system injury, *a sequence hitherto unproven in medicine*, the purpose of the Vaccine Act's preponderance standard is to allow the finding of causation in a field *bereft of complete and direct proof of how vaccines affect the human body." Althen*, 418 F.3d at 1280 (emphasis added).

Under *Althen* prong two, petitioner must prove "a logical sequence of cause and effect showing that the vaccination was the reason for [her] injury." *Althen*, 418 F.3d at 1278. This prong is sometimes referred to as the "did it cause" test; i.e. in this particular case, did the vaccine(s) cause the alleged injury. *Broekelschen,* 618 F. 3d at 1345 ("Because causation is relative to the injury, a petitioner must provide a reputable medical or scientific explanation that pertains specifically to the petitioner's case"). Temporal association alone is not evidence of causation. *See Grant v. Sec'y of Health & Human Servs.,* 9556 F.2d 1144, 1148 (Fed. Cir. 1992). This sequence of cause and effect is usually supported by facts derived from petitioner's medical records. *Althen*, 418 F.3d at 1278; *Andreu*, 569 F.3d at 1375-77; *Capizzano*, 440 F.3d at 1326; *Grant*, 956 F.2d at 1148.

Althen prong three requires establishing a "proximate temporal relationship" between the vaccination and the injury alleged. *Althen* at 1281. That term has equated to the phrase "medically-acceptable temporal relationship." *Id.* A petitioner must offer "preponderant proof that the onset of symptoms occurred within a timeframe which, given the medical understanding of the disorder's etiology, it is medically acceptable to infer causation." *de Bazan v. Sec'y of Health & Human Servs.*, 539 F.3d 1347, 1352 (Fed. Cir. 2008). The explanation for what is

medically acceptable timeframe must align with the theory of how the relevant vaccine can cause an injury (*Althen* prong one). *Id.* at 1352.

The preponderance of the evidence standard requires the petitioner to demonstrate that it is "more likely than not" that the vaccine caused the injury. *Moberly v. Sec'y of Health & Human Servs.*, 592 F.3d 1315, 1322 n.2 (Fed. Cir. 2010). Proof of medical certainty is not required. *Bunting v. Sec'y of Health & Human Servs.,* 931 F.2d 867, 873 (Fed. Cir. 1991). A petitioner must demonstrate that the vaccine was "not only [a] but for cause of the injury but also a substantial factor in bringing about the injury." *Moberly,* 592 F.3d at 1321 (quoting *Shyface v. Sec'y of Health & Human Servs.,* 135 F.3d 1344, 1352-53 (Fed. Cir. 1999); *Pafford v. Sec'y of Health and Human Servs.*, 451 F.3d 1352, 1355 (Fed. Cir. 2006). Causation is determined on a case-by-case basis, with "no hard and fast *per se* scientific or medical rules." *Knudsen v. Sec'y of Health & Human Servs.*, 35 F.3d 543, 548 (Fed. Cir. 1994). A fact-finder may rely upon "circumstantial evidence" which is consistent with the "system created by Congress, in which close calls regarding causation are resolved in favor of injured claimants." *Althen,* 418 F. 3d at 1280.

The petitioner often presents expert testimony in support of his or her claim. *Lampe v. Sec'y of Health & Human Servs.,* 219 F.3d 1357, 1361 (Fed. Cir. 2000). Expert testimony in the Vaccine Program is usually evaluated according to the factors set forth in *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 594-96 (1993); *see also Cedillo,* 617 F.3d at 1339 (citing *Terran v. Sec'y of Health & Human Servs.,* 195 F.3d 1302, 1316 (Fed. Cir. 1999). A special master may use the *Daubert* framework to evaluate the reliability of expert testimony, but expert testimony need not meet each *Daubert* factor to be reliable. *Boatmon v. Sec'y of Health & Human Servs.*, 941 F.3d 1351 (Fed. Cir. 2019). The *Daubert* factors are "meant to be helpful, not definitive," and all factors "'do not…necessarily apply even in every instance in which the reliability of scientific testimony is challenged.'" *Boatmon,* 941 F. 3d at 1359 (citing *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 151, 119 S. Ct. 1167, 143 L.Ed.2d 238 (1999). Thus, for Vaccine Act claims, a "special master is entitled to require some indicia of reliability to support the assertion of the expert witness." *Moberly* at 1324. Where both sides offer expert testimony, a special master's decision may be "based on the credibility of the experts and the relative persuasiveness of their competing theories." *Broekelschen v. Sec'y of Health & Human Servs.,* 219 F.3d 1339, 1347 (Fed. Cir. 2010) (citing *Lampe,* 219 F.3d 1357 at 1362).

If the petitioner makes a *prima facie* case supporting vaccine causation-in-fact, the burden shifts to respondent to show by a preponderance of the evidence that the injury is instead due to factors unrelated to the administration of the vaccine. *Deribeaux v. Sec'y of Health & Human Servs.*, 717 F.3d 1363, 1367 (Fed. Cir. 2013) (citing Section 13(a)(1)(B)). Respondent has the burden of demonstrating that: "[A] factor unrelated to the vaccination is the more likely or principal cause of injury alleged. Such a showing establishes that the factor unrelated, not the vaccination, was 'principally responsible' for the injury. If the evidence or alternative cause is seen in equipoise, then the government has failed in its burden of persuasion and compensation must be awarded." *Knudsen,* 35 F.3d at 551.

V. Analysis

A. Petitioner's diagnosis

As a threshold matter, a petitioner must establish that he suffered from the condition for which he seeks compensation. *Broekelschen v. Sec'y of Health & Humn. Servs.,* 618 F.3d 1339, 1346 (Fed. Cir. 2010). "The function of a special master is not to 'diagnose' vaccine-related injuries, but instead to determine 'based on the record as a whole and the totality of the case, whether it has been shown by a preponderance of the evidence that a vaccine caused the [petitioner's] injury.' *Andreu v. Sec'y of Health & Hum. Servs.,* 568 F.3d 1367, 1382 (Fed. Cir. 2009) (quoting *Knudsen v. Sec'y of Health & Hum. Servs.,* 35 F.3d 543, 549 (Fed. Cir. 1994). "Although the Vaccine Act does not require absolute precision, it does require the petitioner to establish an injury-- the Act specifically creates a claim for compensation for 'vaccine-related injury or death.'" *Stillwell v. Sec'y of Health & Hum. Servs.,* 118 Fed. Cl. 47, 56 (2014) (quoting 42 U.S.C. § 300aa-11(c)). Accordingly, the Federal Circuit has established that it is "appropriate for the special master to first determine what injury, if any, [is] supported by the evidence presented in the record" before applying a causation analysis pursuant to *Althen v. Sec'y of Health & Hum. Servs.*, 418 F.3d 1274 (Fed. Cir. 2005). *Lombardi,* 656 F.3d at 1351-53. For the reasons set forth below, I have concluded that the petitioner has preponderantly established that he suffered from small fiber neuropathy.

Petitioner asserts that he suffered from small fiber neuropathy and that his diagnosis is supported by the medical records and the opinion of one of his treating neurologists, Dr. Bobenhouse. *See* Pet'r Exs. 12, 35, 43. Respondent's expert, Dr. Chaudry asserts that petitioner did not suffer from small fiber neuropathy although he could not articulate a specific diagnosis to describe petitioner's condition post-vaccination. *See* Resp. Exs. A, B. Dr. Chaudry's asserted that many of petitioner's signs and symptoms, including joint pain, diminished reflexes, along with "normal" skin biopsy, were inconsistent with small fiber neuropathy. *Id.*; Tr. 202-04. Drs. Kinsbourne and Chaudry agree that the best way to diagnose an individual with small fiber neuropathy is by reviewing a patient's clinical symptoms, and then if necessary, confirming the diagnosis with objective testing. Tr. 78,167. Furthermore, the medical literature submitted by both parties indicates that the diagnosis of small fiber neuropathy can be "particularly difficult," and that the "[d]iagnosis of small fiber neuropathy is determined primarily by the history and physical exam, but functional neurophysiologic testing and skin biopsy evaluation….can provide diagnostic confirmation." *See* Resp. Ex. B, Tab 3 at 1; Pet'r Ex. 66 at 1.

1. Small Fiber Neuropathy: Signs and Symptoms and Diagnostic Criteria

As explained by multiple medical articles filed in this case, small fiber neuropathy is the result of damage to the small-diameter somatic and autonomic unmyelinated C-fibers and/or the thinly myelinated A-delta nerve fibers. Pet'r Ex. 67 at 1; Pet'r Ex. 66 at 2; *see also* Pet'r Ex. 45 at 2 (Dr. Kinsbourne stating, "Small fiber neuropathy implicates C-fibers (unmyelinated) and A-delta fibers (lightly myelinated)"); Resp. Ex. D at 1 ("Small fiber neuropathy is defined as a structural abnormality of small fibers characterized pathologically by degeneration of the distal terminations of small fiber nerve endings.").

The Lacomis, Hovaguimian, Oaklander, Gorson and Themistocleous articles explain that "typical" small fiber neuropathy symptoms begin with sensory disturbances in the feet or hands, followed by progression in a "stocking-glove" distribution, which can feel like tingling or numbness or temperature disturbances. *See* Pet'r Ex. 35 at 1; Pet'r Ex. 66 at 2; Pet'r Ex. 72 at 2; Resp't Ex. D at 3. Hovaguimian and Gorson also indicate that "electric shock-like pain" is also reported in patients with small fiber neuropathy. Pet'r Ex. 66 at 2; Pet' Ex. 72 at 7 ("painful prickling and electrical shooting pains were also common."). Altered temperature sensibility is also a common symptom endorsed in the medical literature. *See* Pet'r Ex. 66 at 2-3; Resp't Ex. D at 4 ("There is often a distal loss of pinprick or thermal sensation). Drs. Chaudry, Kinsbourne, and Bobenhouse all endorsed these symptoms as part of small fiber neuropathy. Resp. Ex. A at 9; Pet'r Ex. 30 at 4; Tr. 35.

Drs. Chaudry, Kinsbourne, and Bobenhouse also agreed that small fiber neuropathy patients will typically have normal strength and tendon reflexes. Tr. 12-13; 62; 171. Hovaguimian and Themistocleous explain that "motor function, light touch, vibration and proprioception" are typically recorded as normal because those are related to large fiber nerves. Pet'r Ex. 72; Resp't Ex. D at 4 at 4.

The Oaklander article explains that SFN patients can also present with other symptoms that are considered "atypical." Pet'r Ex. 67 at 3. For example, chronic fatigue and reduced exertional tolerance in SFN are caused by neuropathic microvasculopathy "as tissues become unable to increase perfusion during peak demand." Pet'r Ex. 67 at 3. Additionally, Oaklander and Gorson found that some SFN patients experienced neuropathic pain in the proximal regions of the limbs, face and trunk, which suggests involvement with the dorsal root ganglia. Pet'r Ex. 67 at 4; Pet'r Ex. 72 at 2. Gorson identified 23 patients that experienced small fiber sensory loss in the proximal regions of their limbs, face and trunk, and characterized pain as "burning, prickling and shooting." Pet'r Ex. 72 at 4-5.

Hovaguimian states that "The history and physical examination findings are still considered the gold standard against which all tests are compared when making a diagnosis of a small fiber neuropathy. A detailed review of the symptoms, rate of progression, and complaints suggestive of autonomic fiber involvement is necessary. *Generally, if a patient presents with a compelling history for a small fiber neuropathy and an appropriate clinical exam, further testing to confirm the diagnosis may be unnecessary."* Pet'r Ex. 66 at 3. Oaklander explains that "when symptoms are non-specific and examination findings are muted or subjective, objective confirmation," may assist in recognizing SFN. Pet'r Ex 67 at 6. EMG and nerve conduction studies, however, are ineffective at testing for small fiber neuropathy. *Id.*; *see also* Pet'r Ex. 66 at 4; Resp't Ex. D at 4. Hovaguimian, Oaklander, and Themistocleous all state skin biopsies, which can measure intra-epidermal nerve fiber ("IENF") density, can assist in the diagnosis of SFN. But the Oaklander, Lauria and Devigili articles warn that there can be false negatives. *See* Pet'r Ex. 67 at 6; Pet'r Ex. 53 at 5 (Identifying four patients with positive SFN symptoms of burning in their feet with normal IENF findings). Further, Lauria and Themistocleous indicate that IENF axonal swelling may be present and can be considered a "marker of pre-degenerative changes." Pet'r Ex. 53 at 1; Resp't Ex. D at 7. The Devigili et al. article submitted by respondent indicated that the diagnosis of small fiber neuropathy can be made absent a positive

skin biopsy. Resp. Ex. B, Tab 3 at 4. The paper explained that the diagnosis of small fiber neuropathy was made when "*at least two* of the following examinations were abnormal: (1) clinical signs of small fiber impairment (pinprick and thermal sensory loss and/or allodynia and/or hyperalgesia), which distribution was consistent with peripheral neuropathy (length or non-length dependent neuropathy); (ii) abnormal warm and/or cooling threshold at the foot assessed by QST; (iii) reduced IENF density at the distal leg." *Id.* at 4.

Additionally, the Gorson, Gemigani, and Oaklander articles explain that small-fiber neuropathy can be "non-length dependent" and that patients will present with symptoms that are not consistent with the traditional stocking-glove distribution. *See* Pet'r Ex. 67 at 4. The Gemignani article explains that "SFN was classified as 'non-length' dependent when the sensory disturbance was restricted to, or predominant in, different body sites, with involvement of face, trunk, and proximal limbs, either sparing the acral extremities or with simultaneous involvement of the proximal and distal areas." Pet'r Ex. 33 at 2; Tr. 84. Oaklander explained that "patchy or proximal distributions suggest targeting of sensory or autonomic cell bodies (ganglionitis or neuronitis) rather than axonopathy." Pet'r Ex. 67 at 4. Consistent with the Oaklander article, Gorson stated that the pattern of neuropathic pain "involving the proximal regions of the limbs, tongue, face, scalp and trunk in the non-length dependent manner" are "suggestive of a ganglionopathy with preferential involvement of small fiber neurons." Pet'r Ex. 72 at 7.

2. Discussion and Finding that Petitioner Has Small Fiber Neuropathy

Overall, I find that petitioner's medical history, examinations, and tests support a diagnosis of small fiber neuropathy by preponderant evidence.

Petitioner's symptoms that are considered "typical of small fiber neuropathy" were first documented around April 3, 2015, beginning with "numbness," and "tingling," and then were consistently documented in his medical records. At petitioner's appointment on April 3, 2015, he reported "paresthesias and dysesthesias of his feet bilaterally." Pet'r Ex. 14 at 102. The numbness began in his feet and began to ascend into his ankles, which was documented at his appointment with Dr. Sundell on April 17, 2015. Dr. Sundell wrote that petitioner "cannot feel the pin being sharp until above the ankles bilaterally" and "cannot feel the pin being sharp until the elbows bilaterally." *See* Pet'r Ex. 24 at 9. Petitioner's numbness and tingling was then consistently reported to multiple providers and recorded on examination. Dr. Bertolini observed that petitioner had decreased sensation on his forearms and hands and numbness and tingling in his calves on October 29, 2015. Pet'r Ex. 14 at 43. These complaints of numbness and tingling appearing in a stocking glove distribution were consistently documented in petitioner's medical records. *See* Pet'r Ex 14 at 57 (Appointment on September 4, 2015 with Dr. Bertolini noting that petitioner was "still having problems with paresthesias and decreased sensation to light touch, cold sensation, and hot sensation diminished in a stocking glove distribution affecting his hands to his elbows bilaterally and affecting his feet and toes up to his knees.); Pet'r Ex. 14 at 26 (January 29, 2016 appointment noting that petitioner was having "chronic numbness, tingling, and paraesthesias of his arms and legs *stocking glove neuropathy."*); Pet'r Ex.18 at 1 (Appointment on September 1, 2016 stating that petitioner "is also still having numbness of the upper extremities, from the elbows down, and the legs, from the knees down."). As Dr. Chaudry

testified during the hearing, "decreased pinprick from elbows and knees down….is something we find for small fiber neuropathy, in a stocking-glove pattern." Tr. 144; 171.

Additionally, at multiple points in petitioner's medical records, an alteration to petitioner's temperature in his feet and hands was noted. *See* Pet'r Ex. 7 at 4 (noting petitioner "does have some paresthesias, with a cold sensation of his hands and feet."); Pet'r Ex. 16 at 3 ("[petitioner] does complain of some sensory type dysesthesias or sensation of coolness involving the feet bilaterally, which is new."); Pet'r Ex. 69 at 1 (petitioner reported that "his feet tingle constantly with increased coldness in his feet."); Pet'r Ex. 29 at 36 (reporting that petitioner has "decreased sensation to light touch, cold sensation, and hot sensation diminished in a stocking/glove distribution affecting his hands to his elbows bilaterally and affecting his feet and toes up to his knees."). Petitioner's Quantitative Sensory Testing ("QST") showed that petitioner had elevated vibratory, cooling and heat-pain thresholds, at least the latter two of which are characteristics of small fiber neuropathy. Pet'r Ex. 25 at 2. Dr. Bobenhouse explained that petitioner's QST finding that petitioner had "elevated vibratory, cooling, and heat-pain thresholds," means that it takes "that much more effort to cause that sensation, so it's an increased threshold to try to cause the cold feeling or the warm feeling…and if there's an impairment of that signal, then it would raise the threshold, and so it would decrease the sensitivity for those modalities." Tr. 36-37. Dr. Chaudry, Kinsbourne, and Bobenhouse all agreed that alterations to temperature sensation is also consistent with small fiber neuropathy. Tr. 36, 66, 70, 141.

Over the course of three years, before Dr. Bobenhouse formally diagnosed petitioner with small fiber neuropathy, many of petitioner's treating physicians had suspected that petitioner may have some type of sensory neuropathy. *See e.g.* Pet'r Ex 8 at 7; Pet'r Ex. 14 at 26. Dr. Bobenhouse testified that when petitioner first presented to him, "he certainly had a glove-stocking type of distribution of sensory impairment," and that petitioner was complaining of "severe cold on the dorsal surface of his foot," which symptoms were consistent with small fiber neuropathy. Tr. 32-35. Dr. Bobenhouse also stated that he did not feel that another skin biopsy was necessary because they have a "low yield for determining the etiology for small fiber neuropathy," and that it is "medically reasonable to make a diagnosis of small fiber neuropathy without a skin biopsy." Tr. 38-39.

Despite petitioner consistently endorsing symptoms consistent with small fiber neuropathy as agreed upon by all the experts and having neurological examinations consistent with small fiber neuropathy, Dr. Chaudry focused on petitioner's other symptoms that appeared after the vaccination to conclude that petitioner did not have small fiber neuropathy. His opinion is unpersuasive.

In both his expert report and during the hearing, Dr. Chaudry asserted that joint pain, fatigue, headaches, and weakness do not present with small fiber neuropathy. *See* Resp't Ex. A at 8. I agree with Dr. Chaudry that petitioner's joint pain is unrelated to his diagnosis of small fiber neuropathy. However, it does appear that petitioner's initial symptoms of joint pain and muscle aches, which began two days post-vaccination were consistent with an inflammatory reaction to the Twinrix vaccine. Dr. Kinsbourne credibly explained that muscle aches and joint pain "is a well-known, severe but transitory adverse effect of multiple vaccinations, so that's

consistent with a vaccine reaction." Tr. 50. Dr. Bobenhouse agreed, testifying that petitioner's complaints of joint pain in his hips and shoulders were likely "more of a systemic type response," to the vaccine, but that those specific symptoms were unrelated to the diagnosis of small fiber neuropathy. *Id.* at 30-31. Petitioner's medical records are consistent with Dr. Kinsbourne's opinion. Petitioner's initial complaints of muscle ache, joint pain, and fatigue began two days after he received the vaccine. Pet'r Ex. 15 at 676, 683. When petitioner was initially hospitalized on March 27, 2015, petitioner also had an elevated C-reactive protein and elevated liver enzymes, consistent with an inflammatory response to the vaccine. Tr. 55; *see also* Pet'r Ex. 15 at 190 ("felt the elevated liver function tests were due to systemic process, possibly reaction to the vaccine itself."). Additionally, treating physicians associated petitioner's initial reaction of "myalgias, arthralgias with severe fatigue and body aches" and nausea to him receiving the Twinrix vaccine. Pet'r Ex. 15 at 197.

Further, petitioner's generalized joint pain appears to have resolved by September 2015. *See* Pet'r Ex. 14 at 57-61 ("the myalgais and arthralgias have resolved in the last two weeks and gotten a lot better."). Nearly one year after receiving the vaccine, on March 29, 2016, petitioner reported to Dr. Bertolini that he was working full-time, using a 2-pound sledgehammer without difficulty, but that he is "using more of his neck muscles and upper thoracic back muscles" which was straining them. *Id.* at 16. In September 2016, petitioner sought treatment from orthopedist, Dr. Reckmyer for left hip pain. Pet'r Ex. 29 at 25. After imaging, petitioner was diagnosed with left hip bursitis, left hip femoral acetabular impingement, and mild left hip degenerative disease. *Id.* at 13. Petitioner underwent a left hip bursectomy and windowing of the tensor fascia to relieve his pain in January 2017. *Id.* at 16. Even though petitioner reported having ongoing joint pain to Dr. Gobbo on April 16, 2018, including shoulder and lower extremity joint pain, given petitioner's history of lower back pain, muscle pain associated with his job, hip surgery and prior knee issues, the complaints at this appointment appear to be more consistent with his historical, job related muscle and joint pain, are more orthopedic in nature and not part of small fiber neuropathy.

Dr. Chaudry also focused on the presence of reduced or diminished joint reflexes to suggest that petitioner did not have small fiber neuropathy. While highlighting petitioner's abnormal reflex recordings, Dr. Chaudry minimized petitioner's symptoms and evaluations that were consistent with small fiber neuropathy, making his opinion less persuasive. During the hearing, he acknowledged that exams found "neuropathy from decreased pinprick from elbow and knees down. Now that is something we find for small fiber neuropathy, which is a stocking-glove pattern as reported. But if this were small fiber neuropathy, then your reflexes should not be zero to 1, which they were in this case." Tr. 144. However, Dr. Bobenhouse testified that reflexes vary by individual and that some people may have minimal or absent reflexes depending on the situation, but reflexes is only "one factor that one takes into account when looking at a patient's exam and then trying to determine what the problem is." Tr. 11. Prior to the vaccination, petitioner's reflexes had been recorded as 2 out of 4 or even 2+ out of 4. *See* Pet'r Ex. 15 at 970, 1140. When petitioner's reflexes were tested after receiving the vaccination on April 7, 2015, by neurologist Dr. Sunil Nair, they were 2+ over the knee and ankle, consistent with his reflex recording pre-vaccination. Again, when petitioner's reflexes were tested by Dr. Feely on July 1, 2015 they were recorded as "DTRs +2/4 throughout," which is normal. *See* Pet'r Ex. 9 at 2; Pet'r Ex. 21 at 2.

Further, Dr. Chaudry acknowledged that the recording of petitioner's reflexes was inconsistent throughout the record, with different doctor's recording normal or reduced. *See* Tr. 200. What is consistent throughout petitioner's medical records are examinations that demonstrate that he was experiencing abnormal sensory disturbances consistent with small fiber neuropathy. *See* Pet'r Ex. 14 at 16 ("decreased sensation to pinprick of his forearms and hands"); *Id.* at 27 ("decreased sensation to light touch and pinprick of his hands and arm"); *Id.* at 41 ("still having problems with stocking-glove numbness on extensor surface of the arms bilaterally from the elbows down to fingers and numbness of his knees down to his toes."); Pet'r Ex. 24 at 9 ("He indicates he cannot feel the pin being sharp until above the ankles bilaterally. He indicates he cannot feel the pin being sharp until the elbows bilaterally."). Given the inconsistent reflex recordings in the record and that some of the reflex recordings were consistent with petitioner's pre-vaccination recordings, Dr. Bobenhouse's explanation for why petitioner's reflexes were recorded as diminished or reduced at times is more persuasive.

Dr. Chaudry's opinion that petitioner's skin biopsy rules out small fiber neuropathy is also unpersuasive. Dr. Chaudry opined that Dr. Thaisetthawatkul's opinion of petitioner's skin biopsy was unequivocal and that petitioner's skin biopsy was completely normal. Resp't Ex. A at 6; Tr. 153.

Dr. Thaisetthawatkul ordered a skin biopsy, and two samples were taken from petitioner's right leg. Pet'r Ex. 22 at 24. The biopsy was processed by the University of Rochester Medical Center. *Id.* The finding from petitioner's "right distal leg" was that his epidermal nerve fiber density estimate was 11.1 fibers/mm (normal > 5.2 fibers/mm) and "morphologic analysis shows some small and medium-sized axonal swellings." *Id.* at 7. The sample from his right proximal thigh also showed epidermal nerve fiber density within normal limits and there wereas "no significant axonal swellings." *Id.* Dr. Thaisetthawatkul reviewed petitioner's skin biopsy and interpreted it as "normal" and that it "show[s] no evidence of small fiber neuropathy." *Id.* at 1.

Dr. Kinsbourne and Dr. Bobenhouse indicated that the finding of the swelling of small and medium-sized axons were abnormal. *See* Tr. 24; 73. Dr. Bobenhouse testified that skin biopsies can help confirm a diagnosis of small fiber neuropathy but do little to determine the etiology or help in the treatment. Tr. 38. He stated that he feels that it is medically "reasonable" to make a diagnosis of small fiber neuropathy without a skin biopsy because he is just attempting to manage the symptoms and thus did not pursue another biopsy. Tr. 38.

Dr. Kinsbourne testified that the finding of small and medium sized axonal swelling is indicative of degenerating axons. Tr. 72-73. He stated that "axons swell in the process of degenerating." *Id.* He said that it is the degeneration of the living axons that causes the pain "because as they degenerate, they become hyperactive and they fire, as it were, for no reason. And that causes the burning or shooting pain quality of the neuropathic pain that people with small fiber neuropathy experience." Tr. 73. Both the Lauria and Themistocleous articles support Dr. Kinsbourne's opinion that the presence of axonal swelling is suggestive of degenerative changes to the nerve fibers. *See* Pet'r Ex. 53 at 1; Resp't Ex. D at 7. Lauria explains, "Patients with painful neuropathy frequently showed morphologic modifications of cutaneous nerves, such

as periodic swellings of IENF, which were commonly considered degenerative changes. Axonal swellings can occur in response to damage to the cytoskeleton and transport systems and could precede the loss of IENF." Pet'r Ex. 53 at 1. Additionally, when studying skin biopsies of patients with positive neuropathic pain, Lauria found four patients with persistent burning feet that had normal IENF density but increased axonal swelling. *Id.* at 5. They hypothesized that the "diffuse swellings might represent early evidence of IENF axonopathy," and found that at a follow-up skin biopsy, all patients showed a decrease in epidermal innervation density at the distal leg. *Id.* The Gorson article also explained that morphological abnormalities were commonly found in skin biopsies, including "prominent axonal swelling in the dermis and epidermis." Pet'r Ex. 72 at 7. Dr. Kinsbourne explained that petitioner's skip biopsy sample at his distal leg showed active swelling of the small and medium axons, which would precede epidermal denervation.

Dr. Kinsbourne also explained that a positive skin biopsy is not necessary for the diagnosis of small fiber neuropathy. Tr. 89. The authors of Devigili examined 67 patients with symptoms consistent with small fiber neuropathy and were able to positively diagnosis 11.9% of patients with small fiber neuropathy based on positive QST and abnormal clinical findings. Resp't Ex. B, Tab 3 at 1; Tr. 89. Dr. Kinsbourne also stated that the same authors were unable to explain the correlation between fiber density and neuropathic pain. Tr. 90. Instead, the neuropathic pain is caused by the process of degeneration, making them hypersensitive and "apt to discharge inappropriately, causing severe pain." *Id.* at 91. Although it would have provided a higher level of diagnostic certainty if the skin biopsy had been positive, the evidence of axonal swelling, and the recognition in the literature that SFN can be diagnosed without a positive IENFD test particularly when there are significant clinical symptoms and a positive QST test as was documented in this case, allows the conclusion that the skin biopsy did not rule out SFN and that the diagnosis can be made without it.

Oaklander explains that diagnosing small fiber neuropathy is difficult given the variation of symptoms that patients can experience and that if a patient seeks treatment from different specialists, diagnosing SFN can be missed. Pet'r Ex. 67 at 2. Dr. Oaklander also suggested that there is an overlap between patients who have been diagnosed with small fiber neuropathy and fibromyalgia, noting that approximately 49% of patients with fibromyalgia have SFN. *Id.* Positive sensory symptoms on examination and a positive thermal sensory threshold test can confirm a diagnosis of SFN. *Id.* at 1; *see also* Pet'r Ex. 66 at 3. Additionally, Devigili indicates that approximately 10% of patients with SFN patients that have positive QST testing have normal skin biopsy results. Resp't Ex. B, Tab 3 at 12.

Given petitioner's consistent reports of sensory disturbances in a stocking-glove distribution to multiple providers, examinations that demonstrated such sensory disturbances, and petitioner's positive QST testing, the testimony of petitioner's treating physician, Dr. Bobenhouse, and the expert opinion of Dr. Kinsbourne, I find that the record supports a finding of a diagnosis of small fiber neuropathy.

B. Causation

1. *Althen* prong one

Under the first prong of *Althen*, a petitioner must provide a "reputable medical theory," demonstrating that the vaccine received *can cause* the type of injury alleged. *Pafford*, 451 F.3d at 1355-56. To satisfy this prong, a petitioner's theory must be based on a "sound and reliable medical or scientific explanation." *Knudsen v. Sec'y of Health & Human Servs.,* 35 F.3d 543, 548 (Fed. Cir. 1994). Proof of causation does not "require identification and proof of specific biological mechanisms[.]" *Id.* at 549. "It is not necessary for a petitioner to point to conclusive evidence in the medical literature linking a vaccine to the petitioner's injury, as long as the petitioner can show by preponderance of the evidence that there is a causal relationship between the vaccine and the injury, whatever the details of the mechanism may be." *Moberly v. Sec'y of Health & Human Servs.*, 592 F. 3d 1315, 1325 (Fed. Cir. 2010).

Dr. Kinsbourne opined that petitioner developed small fiber neuropathy, an autoimmune condition that is often considered a variant of Guillain-Barre syndrome ("GBS"), after the Twinrix vaccine triggered an inflammatory response resulting in autoreactive cells attacking the small nerve fibers. Pet'r Ex. 30 at 6; Tr. 94. He testified that small nerve fibers are susceptible to selective attack by antibodies, the same way in which myelinated nerve fibers are attacked in GBS. Tr. 105; Pet'r Ex. 30 at 6 ("Like long nerve fibers, small nerve fibers are potential targets for autoimmune attack in Guillain-Barré Syndrome."). Dr. Kinsbourne acknowledged that no exact or specific causal mechanism has been identified for small fiber neuropathy, however, "the fact that small nerve fibers are often implicated in GBS creates the presumption that long-fiber GBS and short fiber small fiber neuropathy are related in their mechanism of causation." Pet'r Ex. 30 at 6. Dr. Kinsbourne theory was also supported by the medical literature filed in this case.

The Oaklander article explained that small fiber neuropathy can be an immune mediated condition and "appears inflammatory, involving autoreactive B cells." Pet'r Ex. 67 at 6. Dr. Oaklander stated that, "Inflammatory causality was proposed when comprehensive evaluations revealed neither familial, diabetic, nor toxic causes but rather histories of other autoimmune illnesses in 14 of 41 patients and inflammatory blood-test markers in 32 of 36." *Id.* Furthermore, Oaklander noted that "Reports of early onset SFN after infectious exposures, particularly to human papillomavirus vaccination, suggest potential molecular mimicry. Autoreactive SFN also affects adults but is easiest to diagnose in children and otherwise healthy young people without other risk." *Id.* Oaklander stated, "Inflammatory and autoreactive conditions are increasingly linked to [small fiber neuropathy], given the small fibers immune role….Medical histories and blood test results in large studies of patients with idiopathic small fiber neuropathy suggest associations with dysimmunity." *Id.* at 8. During the hearing, Dr. Kinsbourne also testified that Oaklander also observed that the presentation of small fiber neuropathy can resemble Guillain-Barre syndrome. Tr. 102. Oaklander explained:

> We and others have proposed the existence of small fiber-targeting inflammatory SFN, with acute and chronic presentations temporally resembling Guillain-Barre syndrome and chronic inflammatory demyelinating polyneuropathy, and preliminary evidence of episodic relapsing-remitting courses. Unlike in Guillain-Barre syndrome and chronic inflammatory demyelinating polyneuropathy, inflammatory cells are not prominent in SFN biopsies or CSF. Current evidence links autoreactive B cells using complement, with low C4 level implicating the classic or lectin pathways.

Id. at 8. Dr. Kinsbourne testified that the Oaklander article is suggesting that small fiber neuropathy not only appears to resemble GBS or CIDP, but that it can be caused by autoreactive B cells. Tr. 102. He stated that because small fiber neuropathy is "part of an autoimmune disorder," that "it can be triggered by whatever GBS can be triggered by, which is a whole diversity of triggers." Tr. 103. Dr. Kinsbourne testified that "hepatitis B is a well-known notorious cause of GBS, so by the same token, it has to be a potential cause of small fiber neuropathy." *Id.*

The Seneviratne article hypothesized that small fiber neuropathy was a variant of sensory GBS. Pet'r Ex. 61. The authors reviewed the cases of six patients who had pure sensory GBS, but who also had "clinical and electrophysiological features suggestive of small fiber sensory neuropathy." *Id.* Four of the patients reported a preceding illness prior to the onset of acute numbness in the upper and lower limbs. *Id.* All of the six patients had symmetric "stocking-glove" type sensory loss for pinprick and temperature and had intact vibration and proprioception. *Id.* Seneviratne reported that the patients' numbness and peripheral sensory loss appeared to be the symptom that lasted the longest, while the burning dysesthesias appeared to diminish with time. *Id.* at 2. These six patients could fulfill most of the diagnostic criteria for sensory GBS, as they had elevated CSF, symmetric symptoms at onset, acute symptom onset, and progression up to four weeks. *Id.* at 3. The authors opined that small sensory fibers are a possible target for antibodies, in a similar way in which myelin is damaged by antibodies in GBS. *Id.* They wrote, "There is evidence that in peripheral neuropathies, functionally different small fiber systems are affected independently, and selective involvement of different small fiber types is frequent." *Id.* at 3. Dr. Kinsbourne opined that because small fibers can be a target for damage in a similar manner in which the myelinated fibers are targeted by antibodies in GBS, small fiber neuropathy can also be triggered by infections or vaccinations in the same way that GBS can be caused. *See* Pet'r Ex. 30 at 6; Tr. 101.

Dr. Kinsbourne also referred to the Martinez article to support his opinion that small fiber neuropathy can be triggered by the same mechanisms which can cause GBS. Tr. 101; Pet'r Ex. 30 at 6. He testified that the Martinez article indicated that small nociceptive fibers (which transmit pain), are affected in patients that have neuropathic pain in GBS. Tr. 101. The article followed 30 GBS patients and measured their neuropathic pain, along with quantitative sensory testing to determine whether they had small fiber dysfunction as part of the GBS. Pet'r Ex. 71. The study found that "patients with GBS had significantly greater warm, cold and mechanical detection thresholds at the foot (suggestive of hypoesthesia), greater heat pain thresholds (suggestive of hypoalgesia) and lower mechanical pain thresholds/enhancement of pain in response to suprathreshold mechanical stimuli, suggestive of allodynia and hyperalgesia more so than control subjects." *Id.* at 4. The authors also found that the GBS patients that had sensory impairment at the acute stage of GBS predicted residual neuropathic pain. Martinez explained that "a recent study based on skin punch biops[ies] found reduced values for intraepidermal nerve fiber density in GBS patients with a demyelinating form of the disease that were correlated with abnormal thresholds for warm stimuli, indicating that small fiber neuropathy is also an important manifestation of GBS." *Id.* at 6. Martinez used QST to document small fiber dysfunction in GBS patients, and the study found that GBS patients with neuropathic pain had significantly worse heat and cold detection thresholds compared to GBS patients without

neuropathic pain and healthy controls. The study provides additional data that small fibers can be affected in a similar manner as large or medium motor fibers in GBS. *Id.* Martinez wrote, "These findings emphasize the importance of nociceptive fiber impairment (small fibers) in neuropathic pain in GBS at both acute and chronic stages and suggest similarities between the mechanisms of neuropathic pain in GBS and those of small fiber painful sensory polyneuropathies." *Id.* at 1. Dr. Kinsbourne stated that "Given the well-known propensity of vaccination to cause GBS, this is evidence that small fiber neuropathy can also be an element of an autoimmune neurological disorder." Pet'r Ex. 30 at 6.

Additionally, the Pan article Dr. Kinsbourne referenced also supported his opinion that small fiber neuropathy is related to GBS. Pan reviewed skin biopsies of patients with GBS and found that "most dermal nerve bundles had broken apart, and individual dermal nerve axons exhibited pathological signs of axonal degeneration. Some dermal nerves had become beads of axonal debris, consistent with ongoing dermal nerve degeneration." Pet'r Ex. 55 at 9. The authors stated, "Our results indicate that cutaneous innervation is diminished in acute monophasic polyneuropathy of inflammatory or immune-mediated etiology." *Id.* at 12 The authors found that in addition skin biopsy results, changes in thermal thresholds and dysautonomia in the GBS patients, suggested "that small fiber sensory neuropathy is also an important manifestation of GBS, and that GBS should be considered a global neuropathy instead of a pure large-fiber neuropathy." *Id.*

Dr. Chaudry disagreed with Dr. Kinsbourne's characterization that small fiber neuropathy is "akin" to GBS and he also disagreed that molecular mimicry could cause small fiber neuropathy. Tr. 181. Dr. Chaudry stated the papers Dr. Kinsbourne referenced in which neuropathic pain in patients with GBS was associated with small fiber neuropathy were "controversial" and that the GBS patients have a "different kind of pain." Tr. 180. He testified that "nobody's ever shown" that small fiber neuropathy could be caused by molecular mimicry. *Id.* He stated that "Nobody ever treats small fiber neuropathy with IVIg or immune medications[15]….If it was [an] immune attack or molecular mimicry, we would be using it." *Id.* However, the Oaklander article reported on an "uncontrolled study of 55 children and adults with SFN that received 1g/kg or more of IVIG every 4 weeks for three months or longer, and pretreatment pain severity with a mean of 6.3 dropped to 5.2. Three quarters of patients and neurologists reported improvement and 16% of patients entered sustained remission, permitting IVIG withdrawal." Pet'r. Ex. 67 at 9. Gorson reported on a small number of SFN patients being treated with IVIG with some success as well. Pet'r Ex. 72 at 6.

In addition to the multiple articles summarized above filed by petitioner in support of Dr. Kinsbourne's opinion that small fiber neuropathy is related to GBS, I have previously accepted that small fiber neuropathy is akin to GBS where only the small fibers are affected. *See Swaiss v. Sec'y of Health & Human Servs.,* No. 15-286V, 2019 WL 6520791 (Fed. Cl. Spec. Mstr. Nov. 4, 2019). Other special masters have also concluded that small fiber neuropathy is related to or

[15] See *Swaiss v. Sec'y of Health & Human Servs.,* No. 15-286V, 2019 WL 6520791 (Fed. Cl. Spec. Mstr. Nov. 4, 2019). In this case petitioner has been treated with IVIG for small fiber neuropathy at the Stanford University Medical Center approximately monthly for multiple years and IVIG has provided the only source of relief for his symptoms. The proffer in this case included compensation for monthly IVIG on an ongoing basis. No. 1568 ECF 190.

could be considered a variant of GBS. *See Fiske v. Sec'y of Health & Human Servs.,* No. 17-1378V, 2023 WL 8352761, at *26; *Doe v. Sec'y of Health & Human Servs.,* 2007 WL 3120297, at *7-8 (Fed. Cl. Spec. Mstr. Oct. 18, 2007); *see also Quirino v. Sec'y of Health & Human Servs.*, No. 17-989V, 2023 WL 9229145, at * 20-22 (Fed. Cl. Spec. Mstr. Dc. 18, 2023) (finding that large fiber polyneuropathies can include small fiber components and that respondent's expert conceded that "with respect to the immune causes of GBS there may be similarities between the causes of GBS and SFN."). While these cases are not binding, they are persuasive. Furthermore, petitioner has provided sufficient evidence in this case to support Dr. Kinsbourne's opinion that small fiber neuropathy can be a variant of GBS and that the same immune mechanism that can cause GBS, can also cause damage to the small nerve fibers.

While Dr. Chaudry endorsed molecular mimicry as a possible causal mechanism for inducing GBS after an influenza infection, COVID, or *c.jejuni* infection, he argued that there is not proof that molecular mimicry could be a mechanism for the hepatitis A or B infection or vaccination as possibly causing GBS or small fiber neuropathy. *See* Tr. 183. He testified that "nobody's ever shown," that molecular mimicry is the mechanism which can induce small fiber neuropathy. Tr. 181.

However, petitioners are not required to demonstrate a specific biologic mechanism that can cause their disease, nor are they required to provide epidemiological studies in support of their theory. *See Kottenstette,* 861 Fed. App. 433 (Fed. Cir. June 15, 2021) (citing *Knudsen,* 35 F.3d at 549 (reaffirming the principle that "proof of causation does not 'require identification and proof of specific biological mechanisms[.].' "); *Andreu,* 569 F.3d at 1378-79. The Themistocleous article filed by respondent indicated that while there are no satisfactory epidemiological studies of small fiber neuropathy there are "many potential causes of small fiber neuropathy." Resp. Ex. D at 2. The article states that, "The exact pathophysiological mechanisms are unknown, *and the most likely candidate mechanisms include autoantibodies targeted against neuronal proteins (the identity of which is not yet known), and elevated pro-inflammatory cytokines in the skin and dermal vasculitis." Id.* at 3 (emphasis added). The Lacomis article also acknowledged that the causes for "idiopathic small-fiber neuropathy" are still unknown, in the largest category of patients. Pet'r Ex. 51 at 10. However, Lacomis stated that "in some patients with idiopathic small fiber-neuropathy, an inflammatory autoimmune basis has been hypothesized," and he reviewed multiple articles that described patients with onset of small fiber neuropathy after antecedent infections. *Id.* Lacomis observed that "there is evidence that suggests, but does not prove, that infections or autoimmune processes may cause small-fiber neuropathy. Unfortunately, there are no good laboratory markers of the autoimmune process." *Id.* Furthermore, the Oaklander article supports the theory that in many cases small fiber neuropathy is an autoimmune disease, that involves autoreactive B cells. *See* Pet'r Ex. 67 at 6. Oaklander stated that "Inflammatory causality was proposed when comprehensive evaluations revealed neither familial, diabetic, nor toxic causes but rather histories of other autoimmune illnesses in 14 out of 41 patients and inflammatory blood-test markers in 32 out of 36 patients. Corticosteroids benefitted 67% of patients and intravenous immune globulins benefited 5 out of 8 patients. Reports of early onset SFN after infectious exposures….suggests molecular mimicry." *Id.* These articles make clear that identifying an exact mechanism for the cause of SFN is extremely difficult to ascertain, but petitioner does not need to demonstrate such exactness to prevail on *Althen* one.

Additionally, other special masters have found that the hepatitis B vaccine can result in small fiber neuropathy by a mechanism of molecular mimicry. *Quirino v. Sec'y of Health & Human Servs.*, No. 17-989V, 2023 WL 9229145, at *19-20 (Fed. Cl. Spec. Mstr. Dec. 18, 2023); *see also Shaw v. Sec'y of Health & Human Servs.,* No. 01-0707V, 2013 WL 2897425, at * 16 (Fed. Cl. Spec. Mstr. May 24, 2013) (finding the hepatitis B vaccine can cause small fiber neuropathy through molecular mimicry); *Drobbin v. Sec'y of Health & Human Servs.,* No. 14-225V, 2020 WL 3799206, at * 17 (Fed/ Cl. Spec. Mstr. Jan. 21, 2020) (finding that molecular mimicry can cause flu-vaccine induced peripheral neuropathies, including small fiber neuropathy). In *Quirino,* the experts agreed that "infectious and immune causes" are among the causes of small fiber neuropathy and that the hepatitis B virus can cause peripheral neuropathies, including large fiber poly neuropathy. *Quirino*, 2023 WL 9229145, at *20. Furthermore, the special master found that the hepatitis B surface antigen, as contained within the hepatitis B vaccine, can cause peripheral neuropathies, including small fiber neuropathy, through molecular mimicry. *Id.* at 21. Similarly, in *Shaw*, the special master found that the hepatitis B vaccine can cause small fiber neuropathy through molecular mimicry, even though there is not scientifically certain evidence linking the hepatitis B vaccine or any vaccine to the injury of small fiber neuropathy. *Shaw*, 2013 WL 2897425, at *16.

Dr. Kinsbourne acknowledged that the medical literature exploring the actual causes of small fiber neuropathy is sparse, but he credibly explained how the small fibers can be a target of an autoimmune attack when triggered by an infection or vaccination. In conjunction with his opinion, the articles presented indicate that small fiber neuropathy can be immune mediated, and that the pathogenesis of small fiber neuropathy is like that of GBS. *See* Pet'r Ex. 67 at 6; Pet'r Ex. 72 at 6. Furthermore, the articles endorse petitioner's theory that small fiber neuropathy may be caused by an autoimmune process, including molecular mimicry. Therefore, I find that petitioner has provided preponderant evidence to show that the hepatitis A/B vaccine can cause small fiber neuropathy to satisfy *Althen* prong one.

2. *Althen* prong Three

To satisfy *Althen* prong three, petitioner first must establish the "timeframe for which it is medically acceptable to infer causation," and then, they must demonstrate that the onset of the disease occurred in this period. *Shapiro v. Sec'y of Health & Human Servs.,* 101 Fed. Cl. 532, 542-53 (2011); *recons. denied after remand on other grounds,* 105 Fed. Cl. 353 (2012), *aff'd without op.*, 503 F.App'x 952 (Fed. Cir. 2013). A petitioner must offer "preponderant proof that the onset of symptoms occurred within a time frame for which, given the medical understanding of the disorder's etiology, it is medically acceptable to infer causation in fact." *deBazan v. Sec'y of Health and Hum. & Services,* 539 F 3d 1347, 1352 (Fed.Cir. 2008). The explanation for what is a medically acceptable time frame must also coincide with the theory of how the relevant vaccine can cause an injury (the *Althen* prong one requirement).

Dr. Kinsbourne opined that petitioner's small fiber neuropathy symptoms began approximately eight days after his vaccination. Tr. 98. He observed that petitioner had an initial inflammatory reaction to the Twinrix vaccine, that began approximately two-days after the injection. Tr. 54-55. Dr. Kinsbourne testified that petitioner's transient elevations in C-reactive

protein and AST/ALT levels were "consistent with an inflammatory response to the vaccine." Tr. 55. Furthermore, he stated that petitioner's initial reports of joint pain were part of a "well-known, severe transitory adverse effect," of the vaccine, but petitioner's symptoms evolved into small fiber neuropathy. Tr. 50, 55. When petitioner saw Dr. Bertolini on April 3, 2015, petitioner reported "numbness," and "tingling," which was noted as starting on March 26, 2015. Pet'r Ex. 14 at 100. Dr. Kinsbourne testified that the paresthesias and dysesthesias of the feet were the beginning symptoms of petitioner's small fiber neuropathy. Tr. 58. At that same appointment with Dr. Bertolini, petitioner was diagnosed with "paresthesias and dysesthesias of [the] feet bilaterally secondary to hepatitis A and B combination vaccine." *See* Pet'r Ex. 14 at 100.

Dr. Chaudry testified that symptom onset of eight days after vaccination is a "generally accepted time frame for onset with respect to causation from vaccination." Tr. 188. However, he disagreed that petitioner was having small fiber symptoms eight days post-vaccination. *Id.* Dr. Chaudry conceded that petitioner did experience some type of acute reaction to the Twinrix vaccination that resulted in petitioner experiencing joint pains, C-reactive protein changes and abnormal liver function tests but would not diagnose petitioner with small fiber neuropathy. Tr. 207.

The medical records demonstrate that petitioner initially experienced a likely initial inflammatory reaction to the Twinrix vaccine, which manifested as joint pain, fatigue, and weakness. *See* Pet'r Exs. 2, 5 & 6. Approximately eight days after his vaccination, he began to experience symptoms associated with small fiber neuropathy, including paresthesias and dysesthesias of the bilateral feet. Pet'r Ex. 14 at 100. Even as his joint pains began to dissipate, petitioner's symptoms related to the small fiber neuropathy continued. *See* Pet'r Ex. 9 at 1; Pet'r Ex 8 at 5 (endorsing a cold sensation and numbness of his feet); Pet'r Ex 24 at 8 (decreased sensation to pinprick in his feet and hands bilaterally); Pet'r Ex. 14 at 57 (joint and muscle pains had resolved, but still experiencing paresthesias); and Pet'r Ex. 14 at 25 ("chronic numbness, tingling, and paresthesias of his arms and legs, stocking-glove neuropathy due to post-hepatitis A and B vaccine reaction.").

Dr. Chaudry agreed with Dr. Kinsbourne that the onset of an autoimmune condition occurring eight days post-vaccination is a medically acceptable timeframe. The literature discussed above strongly indicates that a significant number of SFN cases are autoimmune, and I have concluded that petitioner did develop autoimmune SFN which petitioner's medical records establish began approximately eight days post-vaccination, I find that petitioner has provided preponderant evidence to establish *Althen* prong three.

3. *Althen* prong Two

Under *Althen* prong two, a petitioner must prove by a preponderance of the evidence that there is a "logical sequence of cause and effect showing that vaccination was the reason for the injury." *Capizzano,* 440 F.3d at 1324 (quoting *Althen,* 418 F.3d at 1278). The sequence of cause and effect must be "'logical' and legally probable, not medically or scientifically certain." *Althen,* 418 F.3d at 1278. The petitioner need not make a specific type of evidentiary showing, i.e., "epidemiologic studies, rechallenge, the presence of pathological markers or genetic

predisposition, or general acceptance in the scientific or medical communities to establish a logical sequence of cause and effect." *Capizzano*, 440 F.3d at 1325. Instead, petitioner may satisfy his burden by presenting circumstantial evidence and reliable medical opinions. *Id.* at 1325-26.

The fact that petitioner has established that the combined hepatitis A & B vaccine can cause SFN, and that petitioner has established that the onset of his SFN began within a medically acceptable timeframe helps establish that he has also demonstrated the vaccine was the but-for cause of his condition. "Evidence demonstrating petitioner's injury occurred within a medically acceptable time frame bolsters a link between the injury alleged and the vaccination at issue under the "but-for" prong of the causation analysis." *Capizzano*, 440 F.3d at 1326. There is a "logical overlap between the three *Althen* prongs, and that evidence that goes to one prong may also be probative for another prong." *Contreras*, 107 Fed. Cl. at 295. Additionally, as I found that petitioner established that he suffered autoimmune small fiber neuropathy with onset occurring about eight days post vaccination, I also find that petitioner has provided preponderant evidence that the March 18, 2015, Twinrix vaccination caused him to suffer small fiber neuropathy. This finding is based on the petitioner's medical records, the opinions of the petitioner's treating providers, the testimony of Dr. Bobenhouse, one of petitioner's treating neurologists, the opinion of Dr. Kinsbourne, and the medical literature.

The medical records show that two days after petitioner received the Twinrix vaccination, he began to experience myalgias and arthralgias. Pet'r Ex. 4 at 1. Petitioner indicated that most of his arthralgias were in his shoulders and hips. *Id.* Petitioner also reported he was fatigued. *Id.* at 3. Dr. Bertolini diagnosed petitioner with "severe bilateral shoulder pain, bilateral hip pain, secondary to possible viral etiology versus the possibility of a rheumatologic disorder, versus the possibility of a reaction to hepatitis B vaccine. *Id.* On March 26, 2015, petitioner went to the emergency department, reporting extreme fatigue, joint pains and achiness since receiving the Twinrix vaccination. Pet'r Ex. 5 at 1. He was treated for pain and discharged. The following day, March 27, 2015, petitioner returned to the emergency department, this time reporting that his weakness and fatigued had worsened. Pet'r Ex. 6 at 4. Petitioner was admitted to the hospital for monitoring. While in the hospital, infectious disease physician Dr. Gobbo noted that petitioner's symptoms began two days post-vaccination. Pet'r Ex. 7 at 2. Dr. Gobbo's impression was, "Vaccine reaction to the Twinrix causing a serum sickness-type reaction and manifests mainly as polyarthralgia and severe fatigue." *Id.* at 3. Both Drs. Bobenhouse and Kinsbourne opined that petitioner initially experienced a systemic response to the vaccine, which is not uncommon. *See* Tr. 31 (Dr. Bobenhouse testifying that petitioner's initial reaction "was more of a systemic type response initially."); Tr. 50 (Dr. Kinsbourne testifying, "…joint pains is a well-known, severe but transitory adverse effect of multiple vaccinations, so that's consistent with a vaccine reaction."). Furthermore, Dr. Kinsbourne testified that petitioner's elevated liver enzymes and c-reactive protein levels that were measured when petitioner was admitted on March 27, 2015, were consistent with an inflammatory response to a vaccine. *See* Pet'r Ex. 6 at 1-2; Tr. 54. Petitioner also had positive surface antibodies to hepatitis B, which would be consistent with an individual who had received a hepatitis vaccine nine days prior and had an immune response.

On April 3, 2015, petitioner reported that he began to experience paresthesias and dysesthesias of his feet bilaterally. Pet'r Ex. 14 at 100. On April 17, 2015, petitioner told neurologist, Dr. Sundell, that since his hospitalization "his feet have felt cold," and "his hands feel like big balloons or like Mario Brothers hands." Pet'r Ex. 24 at 8. On examination, petitioner's motor strength was normal and Dr. Sundell was able to elicit reflexes, but petitioner indicated that "he cannot feel the pin being sharp until above the ankles bilaterally" and that he "cannot feel the pin being sharp until the elbows bilaterally." *Id.* at 9. Dr. Sundell stated that "there is no evidence for Guillain-Barre" but did opine that petitioner's numbness in his hands and feet may be from a sensory neuropathy. *Id.* at 8.

Petitioner's numbness and tingling in a stocking-glove distribution continued, even after his joint and muscle pain mostly resolved. For example, on September 1, 2016, petitioner had an appointment with Dr. Gobbo, when he reported that he had improved joint pain, but was still experiencing numbness "from the elbows down" and "from the knees down." Pet'r Ex. 18 at 1. Dr. Gobbo wrote, "The temporal relation of his symptoms, especially the fatigue and arthralgias, shortly after the Twinrix vaccination, suggests an idiosyncratic reaction to the vaccine as the most likely cause of his problems." *Id.* Dr. Bertolini diagnosed petitioner with "stocking-glove neuropathy due to post-hepatitis A and B vaccine reaction," on January 26, 2016. Pet'r Ex. 14 at 25. When petitioner met with Dr. Bobenhouse on May 11, 2018, he had continued to experience paresthesias and dysesthesias in his feet, forelegs, hands and forearms. Pet'r Ex. 43 at 1.

Even though petitioner's skin fiber density was within normal limits, it did show small and medium sized axonal swelling from the sample taken from his right ankle. Pet'r Ex. 22 at 9. Importantly, his QST assessment was abnormal, showing "elevated vibratory, cooling, and heat-pain thresholds," which is consistent with small fiber neuropathy Pet'r Ex. 25 at 2. Consistent with Hovaguimian and Devigili, diagnosing SFN can be achieved when a clinical examination is consistent with small fiber neuropathy and done without a skin biopsy. *See* Pet'r Ex. 66 at 3 ("The history and physical examination findings still are considered the gold standard against which all tests are compared when making a diagnosis of small fiber neuropathy."); Resp't Ex. B, Tab 3 ("Our study showed that skin biopsy results can be normal in about 10% of patients whom SFN is diagnosed by clinical and QST examination. This finding emphasizes that a multimodal approach to SFN.").

Dr. Bobenhouse credibly testified that he had diagnosed petitioner with small fiber neuropathy based on petitioner's description and history of pain, paresthesias and dysesthesias in the hands and feet and clinical examination. Petitioner's second EMG/NCS and normal strength is also consistent with SFN. The sensory examination revealed decreased sensibility to pinprick and light-touch in the hands and feet bilaterally. Tr. 8-13. Dr. Bobenhouse testified that petitioner's description of shock-like pains is consistent with non-length dependent small fiber neuropathy and also described as a symptom some SFN patients experience in the Hovaguimian article. Tr. 33-34; Pet'r Ex. 66 at 2 ("Many patients also report transient electric shock-like pain, usually lasting only seconds, but quite severe and potentially multiple times per day."). Dr. Bobenhouse also testified that petitioner's complaints of severe cold on his feet were also consistent with a small fiber neuropathy process, as when the nerves that detect cold and hot are damaged, they give off the wrong signals. Tr. 36. He concluded that the petitioner did have small fiber neuropathy and that it was caused by the vaccine.

Petitioner's presentation and disease course are also consistent with the presentation of the petitioner as described in the *Quirino* opinion. The petitioner in *Quirino* received hepatitis B and Tdap vaccines, and approximately 18-hours after vaccination felt sick, with symptoms including headaches, muscle and joint aches, *especially in his neck, shoulders,* lower back and legs. *Quirino,* 2023 WL 9229145, at *4. Additionally, the petitioner expressed a feeling of exhaustion. *Id.* Approximately, six days after vaccination, petitioner began expressing concern for unusual sensation in his hands, and numbness in his hands and feet. *Id.,* at *5. Much like the petitioner in *Quirino,* petitioner in this case experienced an initial reaction to the vaccine that caused similar muscle and joint pains, and extreme fatigue. His symptoms also evolved to numbness and tingling in his hands and feet in a stocking-glove distribution.

While it took three years before petitioner was diagnosed with SFN by Dr. Bobenhouse, many of petitioner's treating physicians opined that petitioner had some type of vaccine reaction. *See e.g.* Pet'r Ex. 7 at 3 ("vaccine reaction to the Twinrix causing a serum sickness-type reaction that manifests as polyarthralgias and severe fatigue."); Pet'r Ex. 8 at 7 ("Differential diagnosis includes a reactive phenomenon such as a post-vaccination…etiology…Sensory neuropathy?"); Pet'r Ex. 14 at 102 ("paresthesias and dysesthesias of the feet bilaterally secondary to the hepatitis A and B combination vaccine."). Furthermore, his symptoms progressed consistently with the description of small fiber symptoms as described in the medical literature. *See* Pet'r Ex. 57 at 2 ("Symptoms may be mild initially, with some patients complaining of vague discomfort in one or both feet….The most bothersome and fairly typical symptom is burning pain in the feet that extends proximally in a stocking-glove distribution and is often accompanied by stabbing or aching pains, electric shock-like or pins-and needles sensations…"); Resp. Ex. D at 3 ("The symptoms of SFN vary between patients both in their severity and their progression. Typically, the sensory symptoms begin in the feet and progress proximally…eventually involving the hands, ie, stocking-glove pattern…patients may comment on altered temperature sensibility."). While the initial symptoms appear to have been an inflammatory reaction to the vaccine or early evidence of non-length dependent SFN symptoms as described in the literature, the length dependent neuropathy symptoms became the predominant and persistent post vaccine symptoms. Finally, even though Dr. Chaudry argued that petitioner did not have small fiber neuropathy, he conceded that petitioner had "some acute sort of reaction with joint pains and some abnormal liver function tests and CRP," secondary to the Twinrix vaccine." Tr. 206. He also agreed that the physical exams that identified decreased pinprick from the elbows and knees down is something that is found in small fiber neuropathy. Tr. 144

Finally, there was no evidence supporting an alternative cause to explain petitioner's numbness and tingling and sensitivity to cold in the extremities in a stocking glove distribution. There is no evidence that the petitioner had another condition that could cause SFN and there was no evidence of a prior infection prior to the development of small fiber neuropathy.

After a review of petitioner's medical records, the medical literature and the testimony from the experts including his treating physician, Dr. Bobenhouse, I find that petitioner has presented preponderant evidence in support of *Althen* prong two. The petitioner established by a preponderance of the evidence that he developed small fiber neuropathy and that a substantial number of small fiber neuropathy cases are autoimmune in nature. As discussed above, petitioner

also established that the hepatitis A and B vaccine can trigger an immune response that can give rise to small fiber neuropathy through molecular mimicry to satisfy *Althen* prong one. Accordingly, I have concluded that he developed persistent small fiber neuropathy symptoms beginning eight days after the vaccination following an initial inflammatory response to the vaccine, with no prior history of any similar symptoms or alternative causal explanation and that he has established a logical cause and effect relationship with the Twinrix vaccine. Therefore, petitioner has preponderantly established that there is logical sequence of cause and effect between his vaccination and his small fiber neuropathy and satisfied *Althen* prong two.

VI. Conclusion

Upon review of all the evidence submitted in this matter, including the medical records, experts' opinions, medical literature and testimony, I conclude that petitioner has provided preponderant evidence in support of his claim that the hepatitis A and B vaccine he received on March 18, 2015, caused him to develop small fiber neuropathy. He is therefore entitled to compensation under the Vaccine Act. A separate damages order will be issued shortly.

IT IS SO ORDERED.

s/Thomas L. Gowen
Thomas L. Gowen
Special Master